Technical Report IRRP-98-4
April 1998

US Army Corps of Engineers
Waterways Experiment Station

Installation Restoration Research Program

Toxicity of Military Unique Compounds in Aquatic Organisms: An Annotated Bibliography (Studies Published Through 1996)

Published by Environmental Laboratory

Prepared for Headquarters, U.S. Army Corps of Engineers

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by Environmental Laboratory

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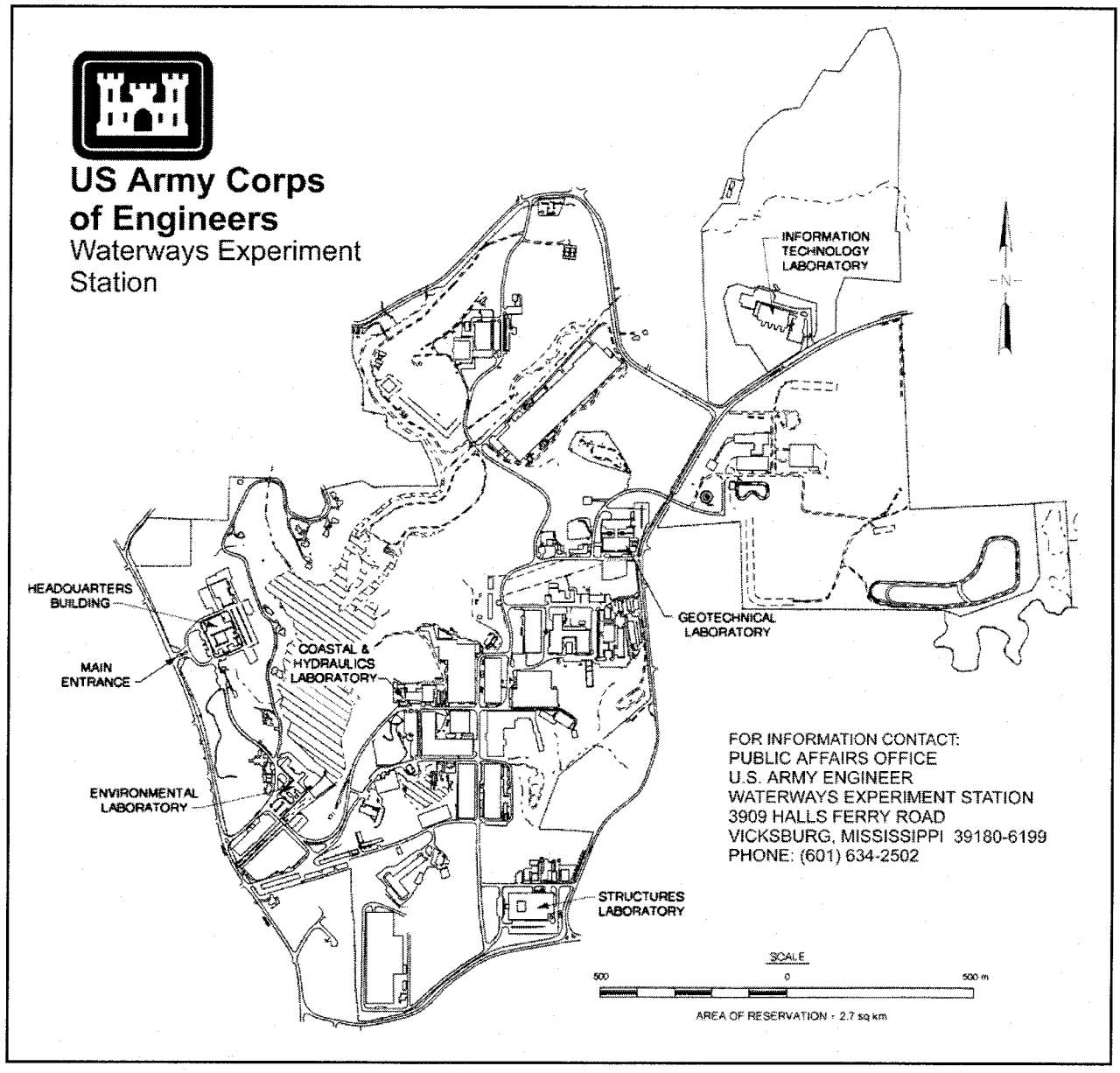
Final report

Prepared for U.S. Army Corps of Engineers
Washington, DC 20314-1000



Waterways Experiment Station Cataloging-in-Publication Data

Toxicity of military unique compounds in aquatic organisms : an annotated bibliography (studies published through 1996) / by Environmental Laboratory ; prepared for U.S. Army Corps of Engineers.

93 p. : ill. ; 28 cm. — (Technical report ; IRRP-98-4)

Includes bibliographic references.

1. Aquatic organisms — Effect of military compounds on. 2. Explosives, Military —Toxicology. 3. Munitions — Toxicology. I. United States. Army. Corps of Engineers. II. U.S. Army Engineer Waterways Experiment Station. III. Environmental Laboratory (U.S. Army Engineer Waterways Experiment Station) IV. Installation Restoration Research Program. V. Series: Technical report (U.S. Army Engineer Waterways Experiment Station) ; IRRP-98-4.

TA7 W34 no.IRRP-98-4

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Preface

This effort was sponsored by the Department of Army Installation Restoration Research Program (IRRP). Dr. Clem Meyer was the IRRP Coordinator at the Directorate of Research and Development, Headquarters, U.S. Army Corps of Engineers. Dr. M. John Cullinane, U.S. Army Engineer Waterways Experiment Station (WES), was the IRRP Program Manager.

WES acknowledges the assistance of Ms. Kelly Christian, Computer Data Systems, Inc., and Ms. Jimmie Perry, WES Research Library, in the compilation of this document. Research for this report was under the direction of Ms. Alfreda B. Gibson and Dr. David W. Moore, Fate and Effects Branch (FEB), Environmental Processes and Effects Division (EPED), Environmental Laboratory (EL), WES. Permission to use the abstracts included in this report was granted by the on-line databases listed herein.

General supervision was provided by Dr. John Harrison, Director, EL. Direct supervision was provided by Dr. Richard E. Price, Chief, EPED, and by Dr. Bobby L. Folsom, Jr., Chief, FEB.

Dr. Robert W. Whalin was Director of WES at the time of publication of this report. COL Robin R. Cababa, EN, was Commander.

This report should be cited as follows:

Environmental Laboratory. (1998). "Toxicity of military unique compounds in aquatic organisms: An annotated bibliography (studies published through 1996)," Technical Report IRRP-98-4, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Introduction

The U.S. Army Environmental Quality Technology Program, which is based on the Army's Environmental Strategy for the 21st century, is composed of four major areas or pillars (cleanup, compliance, conservation, and pollution prevention). The cleanup pillar includes research to address the environmental fate and effects of military unique compounds (MUCs).

The goal of the fate and effects thrust area is to provide superior, cost-effective technology to define contaminant fate, transport, toxicology, and risk/hazard assessment. This information will be used to facilitate more rapid and cost-effective environmental assessments of installations identified for closure under the Base Realignment and Closure program as well as to ensure improved assessments of contaminated sites on active installations. An objective of the risk/hazard thrust is to develop tools to better define the exposure conditions, adverse effects, and the ecological risks posed by MUCs in aquatic ecosystems. In support of this objective, an annotated bibliography was prepared to establish a baseline for information on the effects of MUCs in aquatic ecosystems.

Over 100 published studies on the effects of MUCs on aquatic organisms were assimilated from on-line databases. For each study, a full citation is provided, followed by a complete abstract, database accession number, and keywords. In addition, a summary of the databases searched, search terms used, and a list of all keywords along with corresponding authors are provided.

Adams, W. J., Biddinger, G. R., Robillard, K. A., and Gorsuch, J. W. A Summary of the Acute Toxicity of 14 Phthalate Esters to Representative Aquatic Organisms. Environmental Toxicology and Chemistry. 1995; 14(9):1569-1574.

Acute aquatic toxicity studies were performed with 14 commercial phthalate esters and representative freshwater and marine species. Static acute tests were performed with fathead minnow (*Pimephales promelas*), bluegill sunfish (*Lepomis macrochirus*), waterflea (*Daphnia magna*), midge (*Paratanytarsus parthenogenetica*), green algae (*Selenastrum capricornutum*), mysid shrimp *(Mysidopsis bahia*), and sheepshead minnow (*Cyprinodon variegatus*). Flow-through acute toxicity tests were conducted with rainbow trout (*Salmo mykiss*) and fathead minnow. The 14 esters were dimethyl phthalate diethyl phthalate dinbutyl phthalate butyl benzyl phthalate dihexyl phthalate butyl 2-ethylhexyl phthalate di-(n-hexyl, n-octyl, n-decyl) phthalate di-(2- ethylhexyl) phthalate diisooctyl phthalate diisononyl phthalate di-(heptyl, nonyl, undecyl) phthalate diisodecyl phthalate diundecyl phthalate and ditridecyl phthalate. Phthalate esters with alkyl chain lengths of four carbon atoms or fewer were determined to be acutely toxic at concentrations ranging from 0.21 to 377 mg/L depending on the ester and the solubility of the test chemical in water. There was a general trend for the lower molecular-weight phthalate esters (C sub(1) to C sub(4) alkyl chain lengths: dimethyl phthalate diethyl phthalate dinbutyl phthalate and butyl benzyl phthalate) to become more toxic with decreasing water solubility for all species tested. There were only minor differences in species sensitivity to each of the phthalate esters. Phthalate esters with alkyl chain lengths of six carbon atoms or more were not acutely toxic at concentrations approaching their respective aqueous solubilities. Insufficient mortality occurred to calculate either LC_{50} or EC_{50} values or acute no-observed-effect concentrations for these higher molecular-weight phthalate esters. The lack of toxicity observed for the higher molecular-weight phthalate esters resulted from their limited water solubility (less than or equal to 1.1 mg/L).

Water Resources Abstract (WRA): 3825528

Toxicity Testing/Aquatic Organisms/Aquatic/Phthalate Esters/Chemicals/Acute Toxicity/Esters/Exposure/Life/Water Pollution Effects/Toxicity Tests/Lethal Effects/Exposure Tolerance/Mortality Causes/Organic Compounds/Mortality/ *Paratanytarsus parthenogenetica*/Chironomidae/Diptera.

Anonymous. New Daphnia Test Measures Wastewater Toxics. Water and Pollution Control. 1980; 118:2021.

Daphnia magna, tiny, highly sensitive aquatic animals, were used to measure toxicity levels of acenapthene, acrolein, acrylonitrile, 2,4-dinitrotoluene, 1,2-diphenylhydrazine, and a number of phenolic compounds, before and after the samples had been treated by wet air oxidation (WAO). To determine toxicity levels, starting samples were diluted with local spring water until a concentration was reached that immobilized 50 percent of the *Daphnia* after a 49-hr period-the 48-hr EC_{50} value. Then the solutions were processed through WAO, where they were mixed with air, brought to pressures of 70-140 kg/cm^2, and oxidized at several different temperatures from 150 to 320 °C. In WAO, organic material

reacts with O_2 to bring about a liquid phase oxidation which can reduce complex molecular compounds to simpler ones. After the oxidation, the WAO effluents were diluted, and *Daphnia* were used again to find the 48-hr EC_{50} of the oxidized material. A comparison of the two values established the degrees of toxic reduction. During 1 hr of oxidation at 320 °C, >=99.8 percent of the starting compounds had been destroyed. At that temperature, the oxidation solutions were less toxic than the starting materials by factors 15-4,000, depending on the particular compound.

Toxic Materials/Organic Compounds/Wastewaters/Oxidation/Contaminant Removal/Toxicity/Aquatic Organisms/Water Pollution/Crustaceans/Measuring Methods/Aldehydes/Aromatic Compounds/Pesticides.

Bailey, H. C., Spanggord, R. J., Javitz, H. S., and Liu, D. H. W. Toxicity of TNT (Trinitrotoluene) Wastewaters to Aquatic Organisms. Chronic Toxicity of 2,4-dinitrotoluene and Condensate Water. SRI International, Menlo Park, CA. 1984; 4:91.
This report is the last in a series of four reports on the toxicity of 2,4,6-trinitrotoluene (TNT) wastewaters to aquatic organisms. The information presented in the four volumes was developed in a study performed by SRI International for the U.S. Army Medical Research and Development Command (USAMRDC). The study was undertaken to assist USAMRDC in developing a database for assessing the potential hazards to aquatic life of wastewater from TNT manufacturing and processing plants. This report presents and discusses the results of early life stage and chronic studies on 2,4-dinitrotoluene (2,4-DNT), condensate water, and photolyzed condensate water. 2,4-DNT is a major component of the condensate wastewater that results from treatment of the effluent (red water) that comes from the continuous production of TNT. Condensate water is a synthetic blend based on the actual condensate wastewater and developed by SRI under a separate contract. Early life stage studies were conducted on 2,4-DNT and condensate water with rainbow trout, channel catfish, and fathead minnows. Full life cycle chronic studies were performed on 2,4-DNT and condensate water with fathead minnows and *Daphnia magna* and on irradiated condensate water with *D. magna*.

National Technical Information Service (NTIS): ADA153 536/8/XAB

Aquatic Organisms/DNT/Waste Water/Toxicity/Condensation/Fishes/TNT/ Munitions Industry/*Daphnia*/Life Cycle Testing/Water Quality.

Bailey, H. C., Spanggord, R. J., Javitz, H. S., and Liu, D. H. W. Toxicity of LAP Wastewater and 2,4,6-trinitrotoluene. SRI International, Menlo Park, CA. 1985 May: 80.
Early life stage tests were performed with LAP water (a 1.6:1 mixture of TNT and RDX) and TNT using rainbow trout, fathead minnows, and channel catfish as test organisms. Chronic toxicity studies were performed with TNT and LAP water using fathead minnows and *Daphnia magna* as test organisms. A chronic study was also performed with irradiated LAP water using *Daphnia magna*. Based on the data from these studies as well as prior acute studies, water quality

criteria based on USEPA-recommended procedures were developed for LAP water and TNT. For both LAP water and TNT, concentrations of 1.3 and 0.9 mg/L, respec-tively, should not be exceeded in a 24-hr period. For LAP water, 0.19 mg/L should be considered the 24-hr average allowable concentration. For TNT, a concentration of 0.04 mg/L should be used as an interim 24-hr aver-age allowable concentration until a chronic no effect level is experimentally defined for fathead minnows exposed to TNT.

National Technical Information Service (NTIS): ADA164 282/6/XAB

Toxicity/Waste Water/Fishes/*Daphnia*/Aquatic/Organisms/Channels/ Minnows/RDX/TNT/Trout/Water Quality/Water Pollution/Environmental Impact/Water Quality.

Bailey, H. C., Spanggord, R. J., Javitz, H. S., and Liu, D. H. W. Toxicity of TNT Wastewaters to Aquatic Organisms. Volume 3. Chronic Toxicity of LAP Wastewater and 2,4,6-Trinitrotoluene. SRI International, Menlo Park, CA. 1985 May; See also Volume 4:80.
Early life stage tests were performed with LAP water (a 1.6:1 mixture of TNT and RDX) and TNT using rainbow trout, fathead minnows, and channel catfish as test organisms. Chronic toxicity studies were performed with TNT and LAP water using fathead minnows and *Daphnia magna* as test organisms. A chronic study was also performed with irradiated LAP water using *Daphnia magna*. Based on the data from these studies as well as prior acute studies, water quality criteria based on USEPA-recommended procedures were developed for LAP water and TNT. For both LAP water and TNT, concentrations of 1.3 and 0.9 mg/L, respectively, should not be exceeded in a 24 hr period. For LAP water, 0.19 mg/L should be considered the 24-hr average allowable concentra-tion. For TNT, a concentration of 0.04 mg/L should be used as an interim 24-hr average allowable concentration until a chronic no effect level is experimentally defined for fathead minnows exposed to TNT.

National Technical Information Service (NTIS): ADA164 282/6/XAB

Toxicity/Waste Water/Fishes/*Daphnia*/Aquatic/Organisms/Channels/ Minnows/RDX/TNT/Trout/Water Quality/Water Pollution/Environmental Impact/Water Quality.

Bausum, H. T. Recommended Water Quality Criteria for Octahydro-1,3,5,7-Tentranitro-1,3,5,7-Tetrazocin (HMX). Army Biomedical Research and Development Laboratory, Fort Detrick, MD. 1989 Mar 27:87.
The objectives of this report are to review existing data on HMX, with special reference to those on human, mammalian, and aquatic health effects, and to generate water quality criteria for drinking water and for the

protection of aquatic life and its uses. For this purpose, USEPA methods will be followed; these are summarized in the appendices: Appendix A, derivation of criteria for the protection of aquatic life and its uses (Stephan et al. 1985), and Appendix B, for the protection of human health (USEPA 1980).

National Technical Information Service (NTIS): ADA258 561/0/XAB

HMX/Munitions Industry/Rocket Propellants/Nitramines/Waste Water/ Toxicity/Metabolism/Water Pollution.

Bentley, R. E., Dean, J. W., Ells, S. J., Hollister, T. A., and LeBlanc, G. A. Laboratory Evaluation of the Toxicity of Cyclotrimethylene Trinitramine (RDX) to Aquatic Organisms. EG and G Bionomics, Wareham, MA. 1977 Dec:99.
The toxicity of nitroglycerine to a wide variety of aquatic organisms representing several different trophic levels in aquatic ecosystems was studied. Results of static acute toxicity tests indicate that the acute LC_{50} values are greater than 3 mg/L RDX. There was an apparent lack of bioaccumulation in edible or nonedible tissues or organs in all species tested. Effects were observed on growth at 5.8 mg/L RDX during egg and fry studies, on survival at 4.9-6.3 mg/L during chronic exposure of fathead minnows, and on number of young produced per parthenogenetic female at concentrations equal to or greater than 4.8 mg/L. Applying an application factor of 0.1 to the lower limit of observed acute toxicity values (3.6 mg/L, 96-hr LC_{50} for bluegill at pH 6.0), a water quality criterion of 0.35 mg/L RDX is proposed.

National Technical Information Service (NTIS): ADA061 730/8

Toxicity/RDX/Aquatic Organisms/Hazards/Algae/Fishes/Invertebrates/ Water Quality/Chemical Analysis/Standards/Protection/Fresh Water.

Bentley, R. E., LeBlanc, G. A., Hollister, T. A., and Sleight, B. H., III. Acute Toxicity of 1,3,5,7-tetranitrooctahydro1,3,5,7-tetrazocine (HMX) to Aquatic Organisms. Eg and G Bionomics, Wareham, MA. 1977 Apr 29:29.
The acute toxicity of 1357-tetranitrooctahydro-1357 (HMX)was - tetrazocine studied utilizing aquatic organisms representing several different trophic levels in aquatic ecosystems. Generally, no adverse effects of exposure to 32 mg/L HMX were observed among any of the algae species tested. The 7-day old fry of the fathead minnow were the only life stage or species acutely affected. Based on an application factor of 0.05 and a 96-hr LC_{50} for the most sensitive aquatic organism (7-day old fry of the fathead minnow) tested (15 mg/L), a water quality criterion of

0.75 mg/L is proposed for the protection of freshwater aquatic life with an adequate margin of safety.

National Technical Information Service (NTIS): ADA054 981/6

HMX/Toxicity/Aquatic Organisms/Ecosystems/Algae/Fishes/ Invertebrates/Lethality/Water Quality/Fresh Water/Test Methods/ Munitions Industry/Military Facilities/Water Pollution/Waste Water/ Solubility.

Bentley, R. E., Petrocelli, S. R., and Suprenant, D. C. Determination of the Toxicity to Aquatic Organisms of HMX and Related Wastewater Constituents. Part 3. Toxicity of HMX, TAX, and SEX to Aquatic Organisms. Springborn Bionomics, Inc., Wareham, MA. 1984 Oct: 94.

The chronic toxicity of HMX was studied utilizing *Daphnia magna* in a 28-day chronic and fathead minnow in an embryo larval study. No adverse effects of exposure to 3.9 or 3.3 mg/L, respectively, were observed. These concentrations closely approximate the limit of aqueous solubility. The acute toxicity of TAX was studied utilizing aquatic organisms representing several different trophic levels in aquatic systems. Generally, no adverse effects of exposure were observed among any of the algae, fish, or invertebrate species tested. Acute toxicity was observed only for 24-hr-old fathead minnow fry. This effect level closely approximated the limit of aqueous solubility of TAX at 600 mg/L. The acute toxicity of SEX was studied utilizing aquatic organisms representing several different trophic levels in aquatic systems. Generally, no adverse effects of exposure were observed among any of the algae, fish, or invertebrate species tested up to the limit of aqueous solubility of ca. 12 mg/L. SEX was acutely toxic only to 7-day-old fathead minnow fry at a concentration of 10 mg/L, which is close to the aqueous solubility limit.

National Technical Information Service (NTIS): ADA172 385/7/XAB

Toxicity/HMX/Waste Water/*Daphnia*/Fishes/Adverse Conditions/Algae/ Aquatic Biology/Aquatic Organisms/Composition(Property)/ Determination/Exposure(General)/Invertebrates/Limitations/Liquids/ Malnutrition/Microorganisms/SEX(Explosives)/Solubility/Water/Quality/ Embryos/Larvae/ Explosives/TAX(Explosives).

Bentley, R. E., Sleight, B. H., III, and Macek, K. J. Preliminary Evaluation of the Acute Toxicity of Desensitized Primer Compounds and Primer Waste Effluents to Representative Aquatic Organisms. Eg and G Bionomics, Wareham MA. 1975 Nov:35.

The acute toxicity of five desensitized primer compounds and primer manufacturing waste effluents to three freshwater species, *Daphnia magna* (water flea: crustacean), *Lepomis macrochirus* (bluegill: fish), and *Pimephales promelas* (fathead minnow: fish), was determined in static bioassays. The primers tested were trinitroresorcinol (TNR) styphnic acid, lead styphnate (PbTNR), tetracene, pentaerythritol tetranitrate (PETN) and FA 956 priming mixture. The waste effluents were those resulting from the production of TNR, PbTNR, tetracene, and FA 956. In addition, a reagent blank that contained no primer materials but was desensitized by the procedure used for TNR was also tested. To determine the effect of the high pH, resulting from the desensitization process, of test materials, bioassays were performed with *Daphnia magna* and *Pimephales promelas* exposed to neutralized versus unneutralized materials. Results indicated that, except for tetracene, the acute toxicity of the primers and waste effluents tested was due primarily to the high pH resulting from desensitization.

National Technical Information Service (NTIS): ADA026 125/5

Munitions Industry/Water Pollution/Primers/Waste Water/Desensitizing/ Bioassay/Toxicity/PETN/Styphnates/Styphnic Acids/Static Tests/Lead Compounds/pH Factor/Aquatic Organisms.

Bentley, R. E., LeBlanc, G. A., Hollister, T. A., and Sleight, B. H., III. Laboratory Evaluation of the Toxicity of Nitrocellulose to Aquatic Organisms. EG and G Bionomics, Wareham, MA. 1976:40

The acute toxicity of nitrocellulose was studied utilizing aquatic organisms representing several different trophic levels in aquatic ecosystems. No acutely toxic effects of nitrocellulose were observed among any of the fish, invertebrate, or algal species tested except with the green alga *Selenastrum capricornutum*. Studies with sediments containing nitrocellulose indicated no adverse effects among chironomid populations exposed to 540 mg nitrocellulose/kg of sediment over two generations, based on application factor of 0.1 and an EC_{50} of 579 mg/L for the most sensitive aquatic organism tested (*Selenastrum capricornutum*).

National Technical Information Service (NTIS): ADA037 749/9

Nitrocellulose/Water Pollution/Toxicity/Aquatic/Organisms/Algae/ Sediments/Bioassay/Water Quality/Fishes/Munitions Industry.

Bentley, R. E., LeBlanc, G. A., Hollister, T. A., and Sleight, B. H., III. Acute Toxicity of Diisopropyl methyl Phosphonate and Dicyclopentadiene to Aquatic Organisms. EG and G Bionomics, Wareham, MA. 1976:107

The acute toxicity of Diisopropyl methyl phosphonate (DIMP) and Dicyclopentadiene (DCPD) was studied utilizing aquatic organisms representing several trophic levels in an aquatic ecosystem. DCPD was found to be approximately 10X more toxic than DIMP. The eggs and 7-day-old fry of the fathead minnow were the life stages least susceptible to DCPD and DIMP, respectively. Increasing hardness and pH 8.0 appeared to decrease slightly the toxicity of DIMP, while the toxicity of DCPD was not significantly altered by varying water quality parameters. Generally, aging of solutions had little affect on toxicity of DCPD. A 50-percent decrease in toxicity to bluegill was observed for DIMP solutions allowed to age for 96 hr. Essentially no bioconcentration (<1X) was observed for bluegill continually exposed to C(14) DIMP, and the estimated maximum bioconcentration factor for C(14) DCPD was 53X.

National Technical Information Service (NTIS): ADA037 750/7

Phosphonates/Pentadienes/Water Pollution/Aquatic/Organisms/Toxicity/ Bioassay/Munitions Industry/Cyclic Compounds Identifiers/Phosphonate/ Diisopropyl methyl Pentadiene/Dicyclo/Toxicology/Water Pollution Effects(Animals)/Ecosystems/Fishes/Minnows/*Pimephales promelas*/ Bluegills.

Bokn, T. Effects of Acid Wastes from Titanium Dioxide Production on Biomass and Species Richness of Benthic Algae. Hydrobiologia HYDRB8. 1990 Sep 28; 204/5:197-303.

Titanium dioxide wastes are suspected to be toxic to rocky shore communities in an estuary in southeast Norway. An experimental project lasting 2 years examined whether titanium dioxide wastes affected recolonization by rocky shore organisms. The experiments were performed in situ in six tanks (each with 9 cu m of brackish water) at two different levels of salinity. Three different concentrations of industrial waste water were used. The growth season of 1986 was dry and sunny compared with 1987, causing reduction of growth on exposed granite chips compared with controls. At the two highest waste concentrations in the tanks, *Fucus serratus* was observed with necrotic tissue both years, and in 1986 benthic diatoms were scarce.

Water Resource Abstracts: 9104420

Acidic Water/Algae/Chemical Wastes/Estuarine Environment/Norway/ Toxicity-Wastewater Pollution/Water Pollution Effects/Aquatic/Habitats-Bioassay/Diatoms/*Fucus*/Plant Pathology/Titanium Dioxide.

Brammer, J. D., and Puyear, R. L. Identification and Quantification of the Water Soluble Components of JP-4 and a Determination of

Their Biological Effects upon Selected Freshwater Organisms. North Dakota State University, Fargo. Department of Zoology. 1982 Dec 23:161.

This phase of the research entailed the following: I. Repeating and completing work on water solubilities of major JP-4 jet fuel alkylbenzenes at five different temperatures and four different salinities. Work is nearly complete for determining the maximal water solubilities of JP-4 derived alkylbenzenes. II. LC_{50} and MATC for toluenes in fathead minnow embryos, 1-day posthatch proto larvae and 30-day-old fish has been published. III. Metabolism of benzene and toluene, aminopyrine demethylase, and aniline hydroxylase activities by liver subcellular fractions from control and induced rats activities. IV. Toluene metabolism and activities of aminopyrine demethylase and aniline hydroxylase in the liver of Bluegill sunfish Lepomis ssp. V. Bioaccumulation and tissue distribution of 14C benzene and 14C toluene by fathead minnows in a closed static bioassay system. VI. The prehatching development of the fathead minnow. VII. Effects of toluene on the prehatching development of the fathead minnow.

National Technical Information Service (NTIS): ADA129 526/0

Jet Engine Fuels/Water Soluble Materials/Fresh Water/Minnows/ Metabolism/Environmental Tests/Liver/Benzene/Alkyl Radicals/ Toluenes/Contamination/Anilines/Hydrolases/Toxicity/Fishes/Embryos/ Aquatic Animals/Bioassay.

Burrows, D., and Dacre, J. C. Mammalian Toxicology and Toxicity to Aquatic Organisms of White Phosphorus and Phossy Water, A Waterborne Munitions Manufacturing Waste Pollutant A Literature Evaluation. Associates Water and Air Resources Engineers, Inc., Nashville TN. 1973 Nov:52.

Elemental white phosphorus is highly toxic to both experimental animals and man. Ingestion of even small amounts may produce severe gastro-intestinal irritation, bloody diarrhea, liver damage, skin eruptions, oliquria, circulatory collapse, coma, convulsions and death. The fatal dose for man is about 1-1.4 mg/kg. No LD_{50} values have been deter-mined. Acute effects differ considerably from chronic effects. Chronic poisoning (from ingestion or inhalation) is characterized by such effects on the osseous system as bony necrosis (phossy jaw), spontaneous frac-tures, as well as by anemia and weight loss. White phosphorus appears to be noncarcinogenic fed to experimental animals. White phosphorus is also highly toxic to aquatic animals. Crustaceans and many molluscs are more tolerant, but still succumb to phosphorus concentrations of 1 ppm or less.

National Technical Information Service (NTIS): AD777 901/0

White Phosphorus Injuries/Water Pollution/Wastes/Industries/ Ammunition/Toxicity/Aquatic Animals/Laboratory Animals/Experimental Data/Dosage/Ingestion(Physiology)/Mammals/Fishes/Crustacea/Mollusca.

Burrows, D.. and Dacre, J. C. Toxicity to Aquatic Organisms and Chemistry of Nine Selected Waterborne Pollutants from Munitions Manufacture A Literature Evaluation. Army Medical Bioengineering Research and Development Laboratory, Fort Detrick, MD. 1975 May:96.

The literature regarding the toxicity to aquatic organisms and the related chemistry of nine military-relevant compounds was evaluated and reviewed. The selected compounds, munitions manufacturing products of potential concern as waterborne pollutants, are dinitrotoluene, tetryl and picric acid, trinitroresorcinol and lead styphnate, pentaerythritol tetranitrate, nitroguanidine, tetracene, potassium per chlorate, red phosphorus, and strontium salts. Based on the available toxicity data, recommendations were made for further investigations to be conducted on the first seven of the listed compounds. No further toxicity studies have been proposed for red phosphorus and the strontium compounds.

National Technical Information Service (NTIS): ADA010 660/9

Toxicity/Munitions Industry/Ammunition/Water Pollution/Aquatic Animals/Picric Acid/PETN/Phosphorus/Styphnates/Strontium Compounds/Tetryl/Naphthalenes/Chemicals.

Burton, D. T., Fisher, D. J., and Paulson, R. L. Acute Toxicity of a Complex Mixture of Synthetic Hexachloroethane (HC) Smoke Combustion Products: 1. Comparative Toxicity to Freshwater Aquatic Organisms. Environmental Toxicology and Chemistry. 1990; 9:745-754.

The acute toxicity of a synthetic hexachloroethane (HC) smoke combustion products mixture to nine freshwater aquatic organisms was determined. Sympathetic HC smoke combustion products are a complex mixture containing Zn, Cd, As, Pb, Al, CCl4, C2C14, C2Cl6, C6Cl6, and HCl. Juvenile fish exposed to this mixture for 96 hr included the fathead minnow, bluegill, channel catfish, and rainbow trout. Invertebrates tested for 48 hr included the neonate water flea, early young amphipod, midge larva, and the mayfly larva. The effect of the mixture on the growth of the green algae *Selenastrum capricornutum* was also studied. The dissolved components of the synthetic HC smoke combustion products mixture were found to be quite toxic to a number of freshwater species, especially the algae, rainbow trout, and water flea. A test solution containing only 5.6 percent of a stock mixture of these components caused both an algistatic and algicidal effect on the alga. The rainbow trout and the water

flea had 96- and 48-hr LC_{5O}s of 2.2 and 9.3 percent of the stock solution, respectively.

National Technical Information Service (NTIS): ADA299 929/0/XAB

Toxicity/Environmental Impact/Fresh Water/Invertebrates/Aquatic Organisms/Smoke Generators/Chloroethanes/Tests/Mixtures/Solutions/ Smoke Channels/Larvae/Dissolving/Fishes/Algae/Siphonaptera/ Combustion Products/Minnows/Trout/Reprints.

Burton, D. T.,Turley, S. D., and Peters, G. T. Acute and Chronic Toxicity of Hexahydro-1,3,5-Trinitro -1,3,5-Triazine (RDX) to the Fathead Minnow (*Pimephales promelas*). Chemosphere. 1994; 29(3):567-579.

The acute 96-hr LC_{50} for 15 to 17-day-old fathead minnow (*Pimephale promelas*) exposed to Hexahydro-1,3,5- Trinitro-1,3,5-triazine (RDX) in aqueous solution was 12.7 mg/L at 25 °C. A 28-day early life stage (ELS) test with the fathead minnow produced a lowest observed-effect concentration (LOEC) and no-observed-effect concentration (NOEC) based on growth (both wet and dry weight) of 2.4 and 1.4 mg/L, respectively. A review of the literature shows that the chronic toxicity of RDX to fathead minnow is similar when evaluated in ELS, partial life cycle, and complete life cycle tests.

National Technical Information Service (NTIS): ADA285 594/8

Minnows/Toxicity/RDX/Life Cycles/Test and Evaluation/Triazines/ Weight/Chemicals/Fresh Water/Fishes/Water Quality/Aquatic Organisms.

Burton, D. T., and Turley, S. D. Reduction of Hexahydro-1,3,5-Trinitro-1,3,5-triazine (RDX) Toxicity to the Cladoceran *Ceriodaphnia dubia* Following Photolysis in Sunlight. Bull. Environ. Contam. Toxicol. 1995; 55:89-95.

Hexahydro-1,3,5- Trinitro.1,3,5-triazine (RDX) is a high explosive used extensively by the military in a number of applications. The compound may enter the aquatic environment via wastewater during manufacturing activities and blending operations at load, assembly, and pack (LAP) plants. RDX has been shown to be toxic to a number of aquatic organisms including algae, some invertebrates, and fish at concentrations well below its solubility limit in water (Etnier 1986; Burton et al. 1993). Several studies have shown that RDX is decomposed via photolysis in aqueous solutions at UV wavelengths shorter than 290 NM and at longer wavelengths above 290 NM, which can occur from irradiance in natural sunlight (Kubose and Hoffsommer 1977; Glover and Hoffsommer 1979; Spanggord et al. 1980). Liu et al. (1984) found that exposure of

composition B type LAP waste (1.6:1 mixture of 2,4,6-trinitrotoluene and RDX) to simulated sunlight (filtered UV light) reduced toxicity to several aquatic organisms. Photolyzed 2,4,6-trinitrotoluene (no RDX present) was also less toxic. The photolysis of RDX alone was not studied by Liu et al. (1984). The current study was initiated to verify whether or not photolyzed RDX may be less toxic than the parent compound. A 7-day chronic test with the Cladoceran, *Ceriodaphnia dubia*, was conducted in order to compare the data with those of Peters et al. (1991) who exposed the organism to the parent compound under the same test conditions.

National Technical Information Service (NTIS): ADA299 654/4/XAB

Photolysis/Toxicity/RDX/Trinitrotoluene/Frequency/Ultraviolet Radiation/Manufacturing/Waste Water/Mixtures/Water/Light/Limitations/ Filters/Solubility/Invertebrates/Aquatic organisms/High Explosives/Algae/ Sunlight.

Burton, D. T., Turley, S. D., and Peters, G. T. Toxicity of Nitroguanidine, Nitroglycerin, Hexahydro-1,3,5-Trinitro-1,3,5-Triazine (RDX), and 2,4,6-Trinitrotoluene (TNT) to Selected Freshwater Aquatic Organisms. Maryland University, College Park. Agricultural Experiment Station. 1993 Apr 1:256.
The primary objective of the study was to conduct the necessary toxicity tests to complete the existing database for deriving USEPA numerical water quality criteria for freshwater organisms exposed to nitroguanidine (NQ), nitroglycerin (NG), Hexahydro-1,3,5trinitro-1,3,5-triazine (RDX), and 2,4,6-trinitrotoluene (TNT). A secondary objective of the study was to determine what effect photolysis may have on the toxicity of NQ and RDX. The acute toxicity of NQ was established for the hydra (*Hydra littoralis*), Cladoceran (*Ceriodaphnia dubia*), rainbow trout (*Oncorhynchus mykiss*), and fathead minnow (*Pimephales promelas*). The following NQ chronic tests were performed: 7-day Cladoceran, 28-day ELS rainbow trout, and 28-day ELS fathead minnow. Photolyzed NQ was 100-fold more toxic to the Cladoceran than the parent compound. NG acute toxicity was determined for the green alga (*Selenastrum capricornutum*), hydra, Cladoceran, midge (*Paratanytarsus parthenogenticus*), and fathead minnow. The following chronic tests were conducted with NG: 7-day Cladoceran, 60-day ELS rainbow trout, and 28-day ELS fathead minnow. RDX acute toxicity was established for green alga, hydra, midge, Cladoceran, and fathead minnow. The following chronic tests were conducted with RDX: 7-day Cladoceran, nitroguanidine, nitroglycerin, hexahydro-1,3,5trinitro-1,3,5-triazine (RDX), 2,4,6-trinitrotoluene (TNT), acute toxicity, chronic toxicity, photolysis, *Selenastrum capricornutum, Lemna minor, Hydra littoralis, Paratanarsus*

parthenogenticus life cycle, and 28-day ELS fathead minnow. genticus, *Ceriodaphnia dubia, Pimephales promelas, Oncorhynchus mykiss.*

National Technical Information Service (NTIS): ADA267 467/9/XAB

Diptera/Life Cycles/Minnows/Nitroglycerin/Nitroguanidine/Photolysis/ RDX/Secondary/TNT/Test and Evaluation/Toxicity/Triazines/Trout/ Water Quality/Aquatic Organisms/Fresh Water/Fishes/Algae/ Green(Color).

Cairns, J., Jr., Buikema, A. L., Jr., Doane, T. R., and Neiderlehner, B. R. Sublethal Effects of JP4 on Aquatic Organisms and Communities. Virginia Polytechnic Institute and State University, Blacksburg. Center for Environmental Studies. 1984 Jan:64.
In the second year of the AFOSR grant to examine the sublethal effects of water soluble fraction (WSE) of JP-4 jet fuel, we have completed most of the work on the petroleum-derived JP-4. Fractionators have been built and used to generate constant concentrations of the WSE JP-4 that were used to determine the lethal and sublethal effects on bluegill sunfish *(Lepomis macrochirus*) and selected aquatic invertebrates. The dynamic 96-hr LC_{50} for the WSF JP4 for the bluegill was determined to be 26.2 percent. (This is percent of the maximum soluble amount of JP4.) The concentration of the WSE JP-4, which causes a detectable shift in the ventilatory functions (rate and amplitude), was determined to be 5.1 percent WSE. In the second year of research, producing cultures of aquatic invertebrates were established, flow-through test systems were designed and constructed, and toxicity tests with the water soluble fraction (WSE) of petroleum JP-4 were begun with three invertebrates, the oligochaete, *Aeolosoma headleyi*, a benthic collector gatherer; the Cladoceran *Daphnia pulex*, a planktonic filter-feeding crustacean; and the dipteran *Paratanytarsus parthogentica* (Freeman) (=*Tanytarsus dissimilis* Joh.), a substrate-associated collector gatherer.

National Technical Information Service (NTIS): ADA138 807/3

Toxicity/Jet Engine Fuels/Sublethal Dosage/Aquatic/Organisms/Fishes/ Invertebrates/Lethality/Ventilation/Rates/Concentration(Chemistry)/ Exposure(General)/Response(Biology)/Detection/Blood/Osmosis/ Histology/Metabolism/Liver/Test Methods/Microorganisms.

Cairns, J., Jr., Buikema, A. L., Jr., Doane, T. R., and Niederlehner, B. R. Novel Approach for Predicting Sublethal Effects of Toxicants to Aquatic Organisms. Virginia Polytechnic Institute, Blacksburg. 1984 Nov 30:132.

This study compared the effects of water soluble fraction (WSF) of petroleum-derived (P) JP-4, a common military and civilian jet fuel, and shale-derived (SD) JP-4 on survival, growth, ventilatory rate, preference avoidance behavior, and tissue of the bluegill sunfish (*Lepomis macrochirus*) to determine possible interrelationships and to determine which procedures might be most descriptive of sublethal stress. Comparative studies were also run using invertebrates and microbial communities. In acute tests, fish were generally more sensitive to jet fuel WSFs than invertebrates. This is consistent with previous observations on the relative toxicity of the major components, benzene and toluene. No major discrepancies occurred in the chronic sensitivities of fish and invertebrates. Fish ventilatory response appeared to be the quickest and most efficient of the sublethal tests used and provided a reasonable estimate of a chronic effect level. Microbial communities responded to low levels of jet fuel exposure, but toxicant-related effects would probably be short-lived and of limited consequence in field exposures.

National Technical Information Service (NTIS): ADA158 932/4/XAB

Aquatic Organisms/Jet Engine Fuels/Toxicity/Benzene/*Daphnia*/ Invertebrates/Low Level/Microorganisms/Military Applications/ Petroleum Products/Pulex/Sensitivity/Sublethal Dosage/Toluenes/Toxic Agents/Water/Fishes/Communities.

Cooper, R. C., Hunter, L., Ulrichs, P. C., and Danielson, R. Environmental Quality Research Fate of Toxic Jet Fuel Components in Aquatic Systems. California University, Irvine. 1982 Oct:101.
This report describes an investigation into the nature of the toxic components in the jet fuel JP-4. Toxicity evaluation was based on the inhibitory effect of the fuel water soluble extract (WSF) on the hatch ability of *Artemia salina* eggs. JP-4 samples from different sources were shown to differ substantially both in hydrocarbon composition and toxicity. Toxicity tests with individual model hydrocarbons and mixtures indicated that 1) contrary to widely held views, alkane hydrocarbons were substantially (20-50 times) more toxic than aromatics; 2) the major WSF components benzene, toluene, and xylenes (70-90 percent of total) accounted for less than 30 percent of WSF toxicity; and 3) the estimated toxicity of the remaining WSF hydrocarbons was high enough (approximately 2 ppm) to account for the rest of the WSF toxicity. It was concluded that all the JP4 hydrocarbons were toxic, their contribution being dependent on the proportion present in the water soluble fraction, and that JP-4 toxicity was the sum of the toxicities of its component hydrocarbons. Least squares plots have been developed that allow prediction of maximum JP-4 WSF toxicities from 1) benzene/toluene levels in the neat fuel and 2) total hydrocarbon levels in the WSF.

National Technical Information Service (NTIS): ADA122 548/1

Toxicity/Jet Engine Fuels/Aquatic Organisms/Hydrocarbons/Bioassay/ Salinity/Oxygen/Solubility/Water/Mixtures/Benzene/Toluenes/Xylenes/ Crustacea/Eggs.

Dacre, J. C., and Rosenblatt, D. H. Mammalian Toxicology and Toxicity to Aquatic Organisms of Four Important Types of Waterborne Munitions Pollutants-An Extensive Literature Evaluation. Army Medical Bioengineering Research and Development Laboratory, Aberdeen Proving Ground, MD. 1974 Mar.
Work was conducted to provide a summary review and evaluation of the toxicological and related literature on known components of four types of military relevant wastewaters: nitrocellulose and nitroglycerin manufacturing wastes, water from white phosphorus processing, and water from TNT production and processing. The wastes, the most significant toxicological information concerning them, conclusions, and recommendations for future work are described. Four appendices contain detailed literature reviews and evaluations of the toxicology of the known waste constituents to mammalian and aquatic species.

Enviro-line : 7503581

Aquatic Organisms/Toxic Substances/Water Pollution Damage/ Explosives.

Dacre, J. C., and Rosenblatt, D. H. Mammalian Toxicology and Toxicity to Aquatic Organisms of Four Important Types of Waterborne Munitions Pollutants-An Extensive Literature Evaluation. Army Medical Bioengineering Research and Development Laboratory, Aberdeen Proving Ground, MD. 1974 Mar:187.
The purpose of the work is to provide a summary review and evaluation of the toxicological and related literature on known components of four types of military relevant wastewaters. These are nitrocellulose and nitroglycerin manufacturing wastes, “phossy water” (from white phosphorus processing), and “pink water” (from TNT production and processing). The report consists of brief descriptions of the wastes along with the most significant toxicological information concerning them, conclusions, and recommendations for future work. Four appendices contain detailed literature reviews and evaluations of the toxicology of the known waste constituents (or of mixtures) to mammalian and aquatic species.

National Technical Information Service (NTIS): AD778 725/2

Nitrocellulose/Nitroglycerin/Toxicology/Ammunition/Industries/Wastes/ Aquatic Animals/Mammals/DNT/TNT/Phosphorus.

Davenport R., Johnson, L. R., Schaeffer, D. J., and Balbach, H. Photo Toxicology .1. Light enhanced Toxicity of TNT and Some Related Compounds to *Daphnia magna* and *Lytechinus variagatus* Embryos. Ecotoxicology and Environmental Safety 1994; 27:1422.
Many environmental pollutants interact with solar near ultraviolet (nuv) light in a manner that greatly increases their toxic effects. The phenomenon of light-mediated toxicity (phytotoxicity) is only now becoming generally recognized to any significant degree. Manufacture of, and loading munitions with, the explosive 2,4,6-trinitrotoluene (TNT) in past decades caused contamination of soils and sediments at levels exceeding 1,000 ppm and of waters at levels near saturation (100 ppm). Manufacture of TNT produces numerous nitrated byproducts, and most of these compounds, including TNT, can be metabolized by many species, including bacteria, fungi, plants, and mammals. This study investigated the phytotoxicity of TNT, and 2,3, 2,4, 2,6, and 3,4dinitrotoluene (DNT) and diaminotoluene (DAT), and the major metabolites 2amino4,6dinitrotoruene (2A) and 4amino2,6dinitrotoluene (4A), to *Daphnia magna* (acute toxicity) and *Lytechinus variagatus* (sea urchin) embryos (subacute, developmental toxicity). Most of the compounds were weakly toxic or nontoxic in the dark. All were photo toxic to sea urchins. In *D. magna*, 2,3 and 3,4DNT/DAT and 4A were not toxic but were photo toxic, and 2A was toxic and photo toxic; the other isomers were not toxic or photo toxic to this species.

Institute for Scientific Information Genuine Article: MY424

Polycyclic Aromatic Hydrocarbons/Photoinduced Toxicity/Anthracene.

Davidson, K. A., and Hovatter, P. S. Water Quality Criteria for Colored Smokes: Solvent Yellow 33. Oak Ridge National Laboratory, TN. Health and Safety Research Division Corporation. 1987:111.
The available data on the environmental fate, aquatic toxicity, and mammalian toxicity of Solvent Yellow 33, a quinoline dye used in colored smoke grenades, were reviewed. The U.S. Environmental Protection Agency (USEPA) guidelines were used in an attempt to generate water quality criteria for the protection of aquatic life and its uses and of human health. Colored smoke grenades are formulated and loaded at the Pine Bluff Arsenal, Arkansas. During typical production of pyrotechnic items, approximately 1 to 2 percent of the smoke formulation is released into aquatic environment. The primary aquatic system receiving theses discharges is the Arkansas River and associated drainage.

National Technical Information Service (NTIS): AD-A189 374/2/XAB

Aquatic Organisms/Arkansas/Colored Smokes/Dyes/Environmental Impact/Formulations/Grenades/Health/Humans/Mammals/Production/ Protection/Pyrotechnics/Quinolines/Rivers/Smoke Munitions/Toxicity/ Water/Water Quality/Yellow (Color).

Davidson, K. A., Hovatter, P. S., and Sigmon, C. F. Water Quality Criteria for White Phosphorus. Oak Ridge National Laboratory, TN. 1987 Aug:140.
Data obtained from a review of the literature concerning the environmental fate and aquatic and mammalian toxicity of white phosphorus are presented in order to derive Water Quality Criteria for the protection of humans and aquatic organisms and their uses. Laboratory and field studies indicate that white phosphorus is quite toxic to aquatic organisms, with fish being more sensitive than macroinvertebrates. In dynamic bioassays with fishes, bluegill was the most sensitive species. The most sensitive life stages for fathead minnow are 30-day-old and 60-day-old fry. Aquatic macroinvertebrates are more resistant. Bioaccumulation is rapid and extensive, with the greatest uptake in the liver and muscle of fish and the hepatopancreas of lobster; however, depuration occurs within 7 days postexposure. Other toxic effects to aquatic organisms include cardiovascular and histological changes.

National Technical Information Service (NTIS): ADA186 613/6/XAB

Toxicity/Water Quality/White Phosphorus/Environmental Impact/Water Pollution/Aquatic Animals/Aquatic Organisms/Bioassay/Cardiovascular System/Dynamics/Fishes/Histology/Humans/Invertebrates/Liver/Lobster/ Minnows/Muscles/Protection/Sensitivity.

Defoe, D. L., Holcombe, G. W., Hammermeister, D. E., and Biesinger, K. E. Solubility and Toxicity of Eight Phthalate Esters to Four Aquatic Organisms. Environ Toxicol Chem. 1990; 9:623-636.
Solubility values for eight phthalate esters investigated ranged from 0.020 to 121 mg/L. Acute toxicity tests were conducted with fathead minnows (*Pimephales promelas*) and all eight phthalate esters. Acute and chronic tests were conducted with rainbow trout *(Oncorhynchus mykiss*) and Japanese medaka (*Oryzias latipes*) using di-2-ethylhexylphthalate. In addition, the chronic toxicity of the three di-n-butylphthalates and a mixture of these three phthalates were examined using daphnids (*Daphnia magna).* Fathead minnow 96-hr LC_{50} values for di-n-butyl-ortho-phthalate, di-n-butyl-tere-phthalate, di-n-butyl-iso-phtha late, and alpha,w-butylene di(o-(4-hydroxybutoxycarbonyl)- benzoate) were 1.1, 0.61,

0.90, and 121 mg/L, respectively. Di-n-octyl-ortho-phthalate, di-n-ocytl-iso-phthalate, and di-n-octyl-tere-phthalate were not acutely toxic to fathead minnows at concentrations that exceeded the water solubility estimates for each phthalate. Di-2-ethylhexylphthalate was not acutely toxic to any tested species at the highest tested concentrations. No significant adverse effects were observed on hatch ability, survival, or growth of rainbow trout exposed to a mean di-2-ethylhexylphthalate concentration of 0.502 mg/L (the highest concentration tested) in a 90-day embryo-larval test. However, exposure to a mean di-2-ethylhexylphthalate concentration of 0.554 mg/L significantly reduced the growth of Japanese medaka during a 168-day larval test. Significant adverse effects on reproduction occurred in 21-day chronic tests with *D. magna* at concentrations of 1.91, 0.20, and 0.64 mg/L for di-n-butyl-ortho-phthalate, di-n-butyl-iso-phthalate, di-n-butyl-iso-phthalate, and di-n-butyl-tere-phthalate, respectively. A daphnid mixture test with these three phthalates showed complete additivity, which suggests a similar mode of toxic action.

BIOSIS 9020257

Ecology/Environmental Biology-Oceanography/Limnology/Biochemical Studies-General/Biophysics-Molecular Properties/Macromolecules/ Pathology/General/Miscellaneous-General/Reproductive/System-Physiology/Biochemistry/Toxicology-Environmental/Industrial Toxicology/Public Health/Environmental Health-Air/Water/Soil/ Invertebrata/Comparative/Experimental Morphology/Physiology/ Pathology-Arthropod/Branchiopoda/Osteichthyes/Environmental/ Pollutants--Poisoning/Occupational Diseases/Ecology/Oceanography/ Fresh Water/Biochemistry/Biophysics/Macro-Molecular Systems/ Molecular Biology/Pathology/Genitalia--Physiology--pH/Genitalia Metabolism--ME/Reproduction/Air Pollution/Soil Pollutants/Water/ Pollution/Physiology/Comparative/Pathology/Crustacea/Fishes.

DiSalvo, L. H., Guard, H. E., Gray, B., and Lego, J. A. Toxicity of Ordnance Wastes in Aquatic Environments. Naval Biosciences Laboratory, Oakland, CA. 1976 Jan 30:24.

Bioassay toxicity testing was completed on nonbiodegraded picric acid, Otto fuel and Noset A using *Daphnia* sp. and a fish species. The compounds tested were of relatively low toxicity compared with many industrial compounds such as pesticides, polychlorinated biphenyls, and some heavy metals. The 48-hr LC_{50} for *Daphnia* was approximately 65 ppm in picric acid, about 200 ppm in Otto fuel, and about 600 ppm in Noset A. For stickleback(fish) average LC50/96 values were 76, 26, and 236 ppm, respectively. Based on the fish numbers and pervious algal toxicity tests in this research, preliminary effluent guidelines are

recommended as follows: Picric acid should follow local effluent standards for phenols, e.g., 0.5 ml/L as in some California areas. Otto fuel and Noset A levels around 0.5 and 30 mg/L appear to be reasonable until further testing is completed on the toxicity of biodegradation products of these materials. Guidelines for fuels should specify, however, that the fuels be in true aqueous solution, or very finely dispersed, rather than being in insoluble globular forms in effluent streams.

National Technical Information Service (NTIS): ADA126 890/3

Toxicity/Aquatic Animals/Wastes(Industrial)/Ordnance/Fishes/Crustacea/ Contaminants/Picric Acid/Fuels/Effluents/Bioassay/Environmental Impact/Water Pollution.

D'Oliveira, J., Ecole Centrale de Lyon, F., AlSayyed, G., and Pichat, P. Photodegradation of 2-and 3-Chlorophenol in TiO_2 Aqueous Suspensions. Environ Sci Technol. 1990 Jul; 24(7):990(7).
Monochlorophenols constitute an important category of water pollutants, whose toxicity to mammalian and aquatic life is classified as moderate. The photocatalytic degradation of 2-and 3-chlorophenol in a titanium dioxide aqueous suspension was investigated. The rates of photocatalytic disappearance of the two compounds depended on various parameters such as initial concentration, pH, radiant flux, wavelength, mass and type of photocatalyst, and type of photo reactor. Each of these parameters was assessed. The study showed the potentiality of heterogeneous photocatalysis in decontaminating water. The decomposition rate was only slightly affected by the pH over a wide range. The dechlorination and the dearomatization occurred more rapidly than in the absence of TiO_2. However, the complete mineralization needed a substantially longer illumination time; the nonoptimized initial quantum yields were relatively small; and they decreased with increasing radiant fluxes above a limit.

Enviro-line: 9102867

Photodegradation/Chlorophenols/Titanium Dioxide/Decontamination/ Water Pollution Control/Aromatics/pH/Hydrogen Ion Concentration/ Chlorine/Photochemistry/Mathematic Models/Water/Water Purification/ Technology Planning/Toxic Substances Review Classification 19.

Dost, F. N., Reed, D. J., and Wang, C. H. Inorganic Fluoride, Propellant Oxidizers. Volume II. Effects Upon Microorganisms, Fish, and Plants. Oregon State University, Chervils. 1968 Nov:69.
The effects of the inorganic fluoride oxidizing agents, chlorine trifluoride, chlorine pentafluoride, bromine pentafluoride, oxygen trifluoride, nitrogen trifluoride, and tetrafluorohydrazine, upon selected species of

microorganisms, fish, and plants were studied. In acute exposures of less than 1 hr, the interhalogens, as gases, are destructive to plants at atmospheric concentrations of 10-30 ppm, and in aqueous solution, are lethal to fish and microorganisms at concentrations of 10-25 µg fluoride per milliliter. The latter effects result from formation of inorganic acids and various oxidizing species, either of which are lethal alone and which can be neutralized by basic compounds and reducing agents, and by filtration through soil. Oxygen difluoride is toxic to plants at concentrations in air as low as 1.5 ppm over a 30-min exposure period, but has no effect upon aquatic species. Nitrogen trifluoride and tetra-fluorohydrazine are nearly innocuous to nonmammalian organisms.

National Technical Information Service (NTIS): AD684 176

Oxidizers/Toxicity/Fluorides/Oxidizers/Poisonous/Gases/Fluorides/ Fishes/Microorganisms/Plants(Botany)/Liquid Rocket Oxidizers/Gases/ Toxic Tolerances/Ecology/Chlorine Compounds/Bromine Compounds/ Nitrogen Compounds/Fluorides/Oxygen Compounds/Hydrazine.

Driver, C. J., Ligotke, M. W., Downs, J. L., Tiller, B. L., and Poston, T. M. Environmental and Health Effects Review for Obscurant Fog Oil. Battelle Pacific Northwest Laboratories, Richland, WA 1993 Sep:74.

The health and environmental effects of fog oil smoke were reviewed and compared to predicted levels of fog oil materiel in the field during typical testing and training scenarios. Fog oil dispersion and deposition for simulated mechanical vaporization/condensation releases were determined using a modified Gaussian atmospheric plume dispersion model. Human health risks include respiratory discomfort and skin irritation; however, with appropriate respiratory and skin protection, SGF-2 poses no toxic threat to human health during typical test and training exposures. Fog oil is moderately harmful, either chemically or physically, to plants and animals and can accumulate in food chains. Waterfowl are particularly vulnerable to adverse physical and chemical effects of lubricating oils and experience reproductive dysfunction at relatively low levels of exposure. However, specific information on SGF-2 impacts on avian or mammalian wildlife is lacking. The volatile nature of fog oil suggests that any impacts would be rapidly attenuated in the environment. Also, the area of impact under typical testing and training scenarios would be small and no terrestrial population/community structure changes are anticipated from its use. Aquatic systems appear to be the most vulnerable to fog oil toxicity and SGF-2 deposition on aquatic systems should be avoided.

National Technical Information Service (NTIS): ADA271 244/6/XAB

Environmental Impact/Obscuration/Toxicity/Wildlife/Aquatic Organisms.

Drzyzga, O., Carl von Ossietzky Universitat, Oldenburg Germany; Gorontzy, T.; Schmidt, A., and Blotevogel, K. H. Toxicity of Explosives and Related Compounds to the Luminescent Bacterium Vibrio Fischeri Nrrl-b-11177. Arch Environ Contam Toxicol . 1995 Feb; 28(2):229(7).
Aqueous samples of various explosives and their metabolites were subjected to the luminescent bacterium *Vibrio Fischeri* NRRL-B-1117, and the EC_{50} values of the compounds were calculated. The resulting data are tabulated. 2,4,6-trinitrotoluene, 2,6-diamino-4-nitrotoluene, 2-amino-6-nitrotoluene, 4-amino-2-nitrotoluene, 3,4-dinitrotoluene, 2,4,6-trinitrobenzene, 2,4,6-trinitrobenzoic acid, 2,4,6 -trinitrophenyl -N-methylnitramine, and 2,2',4,4',6,6'-hexanitrodiphenylamine were found to be very toxic to aquatic organisms; 2-amino-4,6-dinitrotoluene, 4-amino -2,6-dinitrotoluene, 2,4-dinitrotoluene, 2-amino -4nitrotoluene, hexogen, octogen, and pentaerythritol tetranitrate were found to be toxic to aquatic organisms; and 2,6-diamino-4-nitrotoluene, 2,4,6-triaminotoluene, 2,4,6-trinitrophenol, 2,6-diaminotoluene, 2,4-diaminotoluene, hexamethylenetetramine, and nitroguanidine were found to be less toxic to aquatic organisms.

Enviro-line: 9509817

Explosives/Water Pollution Effects/Toxic Substances/Bioassay.

Drzyzga, O., Gorontzy, T., Schmidt, A., and Blotevogel, K. H. Toxicity of Explosives and Related Compounds to the Luminescent Bacterium *Vibrio Fischeri* Nrrlb11177. Arch. Environ. Contam. Toxicol . 1995; 28(2):229-235.
Aqueous samples containing various explosives, their reduced metabolites, as well as related compounds were subjected to the luminescent bacterium *Vibrio Fischeri* NRRL-B-11177 to determine their ecotoxicological potential. As the most important parameter, the EC_{50} values of 24 test compounds were calculated. The EC_{50} value means the concentration of a chemical compound that is needed to reduce bacterial luminescence by 50 percent. According to the widely accepted classification scheme of Strupp et al. (1990) and of an incubation period of 30 min (Deutsche Einheitsverfahren zur Wasser-, Abwasser-, und Schlammuntersuchung-Testverfahren MIT Wasser organismen; Gruppe L; DIN 38412, L34; DEV 1991) TNT, 26DNT, 2A6NT,4A2NT, 34DNT, TNB, TNBA, TETRYL, and HEXYL must be classified in the category "very toxic to aquatic organisms"; 2A46DNT, 4A26DNT, 24DA6NT, 24DNT, 2A4NT, RDX, HMX, and PETN must be classified in the category "toxic to aquatic organisms"; and 26DA 4NT, TAT, TNPh, 26DAT, 24DAT, HMT, and

NQ can be classified in the category "less toxic to aquatic organisms." EC_{50} values after 30, 60, and 90 min of incubation of the test compounds are presented and discussed. For many of the compounds tested in this study, there are no, or only a few, toxicological data in the literature available.

Explosives/*Vibrio Fischeri*/Toxicity Testing.

Etnier, E. L. Water Quality Criteria for 2,4-dinitrotoluene and 2,6-dinitrotoluene: Final Report. Department of Energy, Washington, DC. 1987 Aug:149.

Based on the evidence of an increased incidence of hepatic carcinomas and hepatic neoplastic nodules in male rats, the recommended criteria to achieve a human health risk of 10 sup-5, 10 sup-6, or 10 sup-7 for 2,4-dinitrotoluene are 1.7, 0.17, and 0.017 µg/L, respectively. It should be noted that the 2,4-DNT used in the bioassay from which the criteria were calculated was 98 percent pure, with the remaining 2 percent comprised of predominantly 2,6-DNT. The possible influence of 2,6-DNT on the results of this study should not be overlooked. Results from a tumor bioassay suggest that pure 2,4-DNT is not carcinogenic, but limitations of the study preclude a definitive statement regarding the carcinogenicity of 2,4-DNT. There are no studies available documenting the systemic toxicity of pure 2,4-DNT, and thus no acceptable daily intake can be calculated. The water quality criterion for 2,6-DNT is derived from the data showing an increased incidence of hepatic carcinomas in male Fischer 344 rats. It should be noted that exogenous factors in the diet can affect the carcinogenicity of the DNT isomers, enhancing the metabolism and hepatic covalent binding of 2,6-DNT in particular. However, 2,6-DNT is unquestionably a potent hepatocarcinogen, and criteria based on this study will give a conservative estimate of the acceptable cancer risk. The recommended criteria to achieve a risk of 10^{-5}, 10^{-6}, or 10^{-7} for 2,6-dinitrotoluene are 68.3, 6.8, and 0.68 ng/L, respectively.

National Technical Information Service (NTIS): DE88000985/XAB

NitroCompounds/Toluene/Animals/Aquatic Organisms/Bioassay/ Biodegradation/Carcinogens/Diet/Explosives/Health Hazards/Human Populations/Occupational Exposure/Toxicity/Water Quality.

Etnier, E. L. Water Quality Criteria for Hexahydro-1,3,5-Trinitro-1,3,5-Triazine(RDX). Oak Ridge National Laboratory, TN. 1986 Jun:118.

Health and environmental effects data were analyzed for RDX and a literature review presented. Information on the toxic effects of RDX on aquatic organisms is limited. From the data that are available, it appears

that freshwater fish are more susceptible to RDX toxicity than freshwater invertebrates, having a range of LC_{50} values from 4.1 to 6.0 mg/L in 96-hr static tests, and 6.6 to 13 mg/L in 96-hr flow-through tests. EC_{50} values (based on immobilization) of >15 mg/L in flow-through tests and >100 mg/L in static tests were reported for four freshwater invertebrate species. Bioconcentration of RDX in freshwater fish appears to be minimal, with values for edible tissue ranging from 1.4 to 1.7. Chronic RDX intoxication in workers is characterized by epileptiform seizures (generalized convulsions) and unconsciousness. Seizures are followed by temporary amnesia, disorientation, and asthenia. No clinical information describing fatal cases of RDX poisoning is available. Oral LD50 values reported in the literature for RDX range from 44 to 300 mg/kg in the rat. During a 2-year feeding study with rats, the major toxic effects of RDX included anemia with secondary splenic lesions, hepatotoxicity, possible CNS involvement, and urogenital lesions. Insufficient data were available to calculate a water quality criterion for aquatic organisms using USEPA guidelines. Based on noncarcinogenic mammalian toxicity data, an ambient water quality criterion for the protection of human health and sensitive populations of 103 µg/L is proposed.

National Technical Information Service (NTIS): ADA169 506/3/XAB

RDX/Environmental Impact/Toxicity/Anemia/Aquatic/Organisms/ Blackout(Physiology)/Clinical Medicine/Convulsive Disorders/Fishes/ Fresh Water/Health/Humans/Intoxication/Invertebrates/Lesions/Surveys/ Physiological Disorientation/Poisoning/Protection/Rats/Restraint/ Secondary/Spleen/Static Tests/Urinary System/Metabolism.

Fisher, D. J., Burton, D. T., and Paulson, R. L. Acute Toxicity of a Complex Mixture of Synthetic Hexachloroethane (HC) Smoke Combustion Products: I. Comparative Toxicity to Freshwater Aquatic Organisms. Environmental Toxicology and Chemistry 1990 Jun; 9(6):745-754

The acute toxicity of a synthetic hexachloroethane (HC) smoke combustion products (munitions) mixture to nine freshwater aquatic organisms was determined. Synthetic HC smoke combustion products, found in the M8 grenade, the M5 smoke pot and, the M4A1 floating smoke pot, are a complex mixture containing Zn, Cd , As, Pb, Al, CCl4, C2Cl4, C2Cl6, C6Cl6, and HCl. Juvenile fish exposed to the mixture for 96 hr included the fathead minnow, bluegill, channel catfish, and rainbow trout. Invertebrates tested for 48 hr included the neonate water flea, early young amphipod, midge larva, and the mayfly larva. The effect of the mixture on the growth of the green alga *Selenastrum capricornutum* was also studied. The dissolved components of the synthetic HC smoke combustion products mixture were found to be quite toxic to a number of

freshwater species, especially the algae, rainbow trout, and water flea. A test solution containing only 5.6 percent of a stock mixture of these components caused both algistatic and algicidal effects on the alga. The rainbow trout and the water flea had 96- and 48-hr LC_{50}s of 2.2 and 9.3 percent of the stock solution, respectively. It must be stressed that these component concentrations are artificially derived levels that were used in an effort to determined LC_{50} valves for the various species. At present, there are no data concerning the actual amounts of these components that could be released to the aquatic environment after use of grenades and smoke pots or after disposal of stockpile munitions.

Water Resource Abstract: 9011849

Acute Toxicity/Aquatic Animals/Aquatic Life/Chlorinated Hydrocarbons/ Munitions Wastes/Toxicity/Water Pollution Effects/Algal Growth/ Aquatic Insects/Crustaceans/Fish/Heavy Metals/Median Tolerance Limit.

Fisher, D. J., Burton, D. T., and Paulson, R. L. Acute Toxicity of a Complex Mixture of Synthetic Hexachloroethane (HC) Smoke Combustion Products: II. Determination of Component Toxicity. Environmental Toxicology and Chemistry. 1990 Jun; 9(6):755-760.
Synthetic hexachloroethane (HC) smoke combustion products are a complex mixture containing Zn, Cd, Pb, Al, CCl4, C2Cl6, C6Cl6, and HCl. These compounds are combustion products of the M8 grenade, M5 smoke pot, and M4A1 floating smoke pot. The dissolved components of the synthetic HC smoke combustion products mixture are quite toxic to a number of freshwater species, especially a green alga, rainbow trout, and water flea. Acute 48-hr static bioassays were conducted with neonate *Daphnia magna* to assess the toxicity of various individual components and mixtures of components of the synthetic HC smoke combustion products mixture. These tests showed that the metals, zinc in particular, were the major toxic component of the mixture. When the chlorinated organics were tested as a group, they caused only minimal toxicity to the daphnids. Because this study was based on artificially derived dissolved component concentrations, information concerning environmental concentrations of the various components after use or disposal of the munitions is necessary to assess possible hazards to aquatic life.

Water Resource Abstract: 9011850
Acute Toxicity/Bioassay/Chlorinated Hydrocarbons/Munitions Wastes/ Water Pollution Effects/Algae/*Daphnia*/Fish/ Heavy Metals/Zinc.

Fisher, D. J., Burton, D. T., and Paulson, R. L. Toxicity of DEDGN (Diethylene glycol Dinitrate), Synthetic-HC Smoke Combustion Products, Solvent Yellow 33 and Solvent Green 3 to Freshwater

Aquatic Organisms. Johns Hopkins University, Shady Side, MD. Environmental Sciences Group. 1987 Jan 15:80.
The acute toxicities of four munitions compounds to nine freshwater aquatic organisms were determined. The munitions were Diethylene glycol Dinitrate (DEGDN), solvent yellow 33, solvent green 3, and synthetic-HC smoke combustion products that are a complex mixture containing zinc, cadmium, arsenic, lead, aluminum, carbon tetrachloride, perchloroethylene, hexachloroethane, hexachlorobenzene, and hydrochloric acid. Fish exposed to the materials for 96 hr included the fathead minnow (*Pimephales promelas*), bluegill (*Lepomis macrochirus*), channel catfish (*Ictalurus punctatus*), and trout (*Salmo gairdneri*). Invertebrates, which were exposed for 48 hr, included the water flea (*Daphnia magna*), amphipod (*Gammarus pseudolimnaeus*), midge larva (*Paratanytarsus parthogenetica*), and mayfly larva *(Hexagenia bilinata*). Growth of the green algae (*Selenastrum capricornutum*) was also tested with all the compounds.

National Technical Information Service (NTIS): ADA188 766/0/XAB

Aluminum/Ammunition/Aquatic Organisms/Arsenic/Chlorobenzene/ Chloroethanes/Crustacea/Fishes/Fresh Water/Hydrochloric Acid/ Invertebrates/Larvae/Minnows/Mixtures/Nitrates/Siphonaptera/Solvent Dyes/Toxicity/Trout/Water/Zinc/Smoke Munitions/Propellants/Water Pollution/Cadmium/Lead(Metal)/Carbon Tetrachloride/Aquatic Biology/ Explosives/Ethylene Glycol.

Fisher, D. J., Burton, D. T., and Paulson, R. L. Toxicity of DEGDN, Synthetic-HC Smoke Combustion Products, Solvent Yellow 33 and Solvent Green 3 to Freshwater Aquatic Organisms. Johns Hopkins University, Shady Side, MD. Environmental Sciences Group. 1987.
The acute toxicities of four munitions compounds to nine freshwater aquatic organisms were determined. The munitions were solvent green 3 and synthetic-HC smoke combustion products that are a complex mixture containing zinc, cadmium, arsenic, lead, aluminum, carbon tetrachloride, perchloroethylene, hexachloroethane, hexachlorobenzene, and hydrochloric acid. Fish exposed to the four materials for 96 hr included the fathead minnow, bluegill, channel catfish, and rainbow trout. Invertebrates, which were exposed for 48 hr, included the water flea, amphipod, midge larva, and the mayfly larva. Growth of the green algae *Selenastrum capricornutum* was also tested with all the compounds. The toxicity of DEGDN was relatively low to the nine freshwater species tested. Toxicity values ranged from a 5-day EC_{50} (growth) of 39.1 mg/L for *S. capricornutum* to a 96 hr LC_{50} of 491.4 mg/L for the fathead minnow. The dissolved components of the synthetic-HC smoke combustion products mixture were very toxic to a number of freshwater

species, especially *S. capricornutum*, rainbow trout, and water flea. A test solution containing only 5.6 percent of a stock mixture of these components caused both an algistatic and algicidal effect on the alga. The rainbow trout and the water flea had 96 and 48 hr LC_{50}s of 2.2 and 9.3 percent of the stock solution, respectively. Solvent yellow 33 and solvent green 3 were not toxic to seven of the nine freshwater species when tested at their solubility limits. (LantzPTT)

Water Resource Abstracts: 8902936

Water Pollution Effects/Toxicity/Ammunition Plants/Organic Compounds/Industrial Wastewater/Heavy Metals/Zinc/Lead/Arsenic/ Cadmium/Aluminum/Fish/Invertebrates/Hydrochloric Acid/Solvents Lethal Limits/Hexachlorobenzene/Perchloroethylene/Hexachloroethane/ Algae.

Goodfellow, W. L., Burton, D. T., Graves, W. C., Hall, L., and Cooper, K. R. Acute Toxicity of Picric Acid and Picramic Acid to Rainbow Trout (*Salmo gairdneri*) and American Oyster (*Crassostrea virginica*). Water Resources Bulletin. 1993; 19:641-648 .
Picric acid (2,4,6-trinitrophenol) and Picramic acid Barral, 19 (2-amino-4,6 initrophenol) are potential water pollutants due to a important variety of industrial and munition uses. The impossible impacts of picric and Picramic acid to two recreationally and commercially important species, rainbow trout, *Salmo gairdneri*, and American oysters, *Crassostrea virginica*, were evaluated. Picramic acid was more toxic than picric acid both species tested. The 96-hr LC_{50}s for picric and Picramic acids for rainbow trout were 109.6 and 46.2 mg/L, respectively. Sublethal no growth EC_{50}s and shell deposition EC_{50}s for oysters showed that both compounds caused adverse effects at much lower concentrations than indicated by the LC_{50}s. For example, the 144-hr shell deposition EC_{50}s were 27.9 mg/L for picric acid and 5.6 mg/L for Picramic acid. Sediment absorption studies in estuarine water indicated that both compounds are not readily absorbed, which suggests that sediment would not play a major role as a sink in contaminated systems. Oysters, which filter large quantities of particulate matter, would more likely be affected by picric and Picramic acids in the water column than by exposure to contaminated sediment.

NTIS Accession Number: AD-A299 644/5/XAB

Toxicity/Picric Acid/Water/Adverse Conditions/Ammunition/ Concentration(Composition)/Particulates/Contamination/Sediments/pH Factor/Estuaries/Oysters/Trout/Picramic Acid

Griest, W. H., Tyndall, R. L., Stewart, A. J., Ho, C. H., and Ironside, K. S. Characterization of Explosives Processing Waste Decomposition Due to Composting. Phase 2. Oak Ridge National Laboratory, TN. 1992 Nov 1:134.
Static pile and mechanically stirred composts generated at the Umatilla Army Depot Activity in a field composting optimization study were chemically and toxicologically characterized to provide data for the evaluation of composting efficiency to decontaminate and detoxify explosives-contaminated soil. Characterization included determination of explosives and 2,4,6-trinitrotoluene metabolites in composts and their USEPA Synthetic Precipitation Leaching Procedure Leachates, leachate toxicity to *Ceriodaphnia dubia* and mutagenicity of the leachates and organic solvent extracts of the composts to Ames bacterial strains TA-98 and TA-100. The main conclusion from this study is that composting can effectively reduce the concentrations of explosives and bacterial mutagenicity in explosives-contaminated soil and can reduce the aquatic toxicity of leachable compounds. Small levels of explosives and metabolites, bacterial mutagenicity, and leachable aquatic toxicity remain after composting. The ultimate fate of the biotransformed explosives and the source(s) of residual toxicity and mutagenicity remain unknown.

National Technical Information Service (NTIS): ADA250 945/3/XAB

Army/Army Facilities/Chemistry/Composts/Determination/Efficiency/ Explosives/Leaching/Metabolites/Optimization/Organic Solvents/ Precipitation/Residuals/Soils/Solvents/Statics/TNT/Toxicity/Urban Areas/ Waste Disposal/Chemical Analysis.

Haag, W. R., Spanggord, R. J., Mill, T., Podoll, R. T., Chou, T., Tse, D. S., and Harper, J. C. Fate of Diethylene Glycol Dinitrate in Surface Waters. Chemosphere 1991; 23(2):215(16).
The physical, chemical, and biological properties that control partitioning and transformation of diethylene glycol Dinitrate (DEGDN) in the aquatic environment were investigated. Overall results indicated that DEGDN exists predominantly in the aqueous phase, and its fate is controlled primarily by photolysis. Its half-life at the water surface ranges from 15 to 59 days in summer and winter, respectively. Degradation products include nitrite, nitrate, and 2-hydroxy ethyl nitrato acetate. In eutrophic waters, photolysis is moderately reduced, but biotransformation is enhanced. Extensive data are presented on water solubility, sediment sorption coefficient, octanol/water partition coefficient, Henry's constant, bioaccumulation by Anabena flosaquae and *Selenastrum capricornutum*, hydrolysis, aquatic biotransformation, and sediment-mediated transformation.

Enviro-line : 9212076

Water Pollution Research/Pollutant Fate/Propellants/Surface Waters/ Photolysis/Biodegradation/Microorganism/Bioaccumulation/Plant/ Aquatic/Ecosystems/Solubility/Liquid/Sediment/Quantitative Analysis/ Data/Chemical/Toxic Substances/Measurements and Sensing Review Classification 19.

Haag W. R., Spanggord, R., Mill, T., Podoll, R. T., Chou, T., Tse, D. S., and Harper J. C. Aquatic Environmental Fate of Nitroguanidine. Environ Toxicol Chem. 1990; 9 (11):1359-1368.
The environmental fate of nitroguanidine (NQ) in surface waters is dominated by photolysis with surface half-lives at 40.ANG. N ranging from 0.6 days in summer to 2.3 days in winter. The environmental quantum yield is 0.01. The NQ is initially photolyzed to nitrite and hydroxy guanidine; nitrite is photochemically converted to nitrate, and hydroxy guanidine undergoes sensitized photolysis to unknown products. The photo oxidation of nitrite is assisted by organic material in a process not involving H_2O_2 or singlet oxygen. Nitroguanidine biotransforms cometabolically; in the absence of extra organic nutrients, the second order rate constant was $(3.8 \pm 0.9) \times 10^{-10}$ ml cel1^{-1} h^{-1}. Half-life estimates for aerobic, aquatic biotransformation range from 1 to 100 days. Cyanamide appears to be an end product of NQ use, and no intermediate biotransformation products were observed. Nitroguanidine is expected to move readily through soils (soil sorption coefficient KP < 0.1); however, anaerobic biotransformation occurs readily in soil, with an estimated half-life of 4 days. Other fate parameters measured at 25.ANG. C are a water solubility of 2,600 100 ppm, octanol/water partition coefficient of 0.148 0.001 (dimension less). Henry's constant of $<7 \times 10^{-6}$ (dimensionless), base hydrolysis constant of $(3 \pm 1) \times 10^{-4}$ M^{-1} S^{1}, neutral hydrolysis constant $\leq 2 \times 10^{-F}$ 5^{-E}, and biouptake constants of 110 g dry cells/g water for *Anabena flos-aquae* and 150 g dry cells/g water for *Selenastrum capricornutum*.

BIOSIS: 9103712

Ecology/Environmental Biology Plant/Ecology/Environmental Biology-Limnology/Biochemical Studies-General/Toxicology-Environmental/ Industrial Toxicology/Public Health/Environmental Health-Air/Water/Soil Pollution/Plant Physiology/Biochemistry/Biophysics Metabolism/ Chlorophyta/Environmental/Pollutants--Poisoning/Occupational Diseases/ Ecology/Plants/Ecology/Fresh Water/Biochemistry/Air Pollution/Soil Pollutants/Water.

Haley, M. V., Checkai, R. T., Kurnas, C. W., and Wentsel, R. S. Toxicity Determination of Explosive Contaminated Soil Leachates to

***Daphnia magna* Using an Adapted Toxicity Characteristic Leaching Procedure. Edgewood Research, Development and Engineering Center, Aberdeen Proving Ground, MD. 1993:20**
An adapted toxicity characteristic leaching procedure was used to determine toxicity of soils to *Daphnia magna*. Soil samples were collected from U.S. military installations where open burning/open detonation (OB/OD) operations have occurred. The samples were extracted with CO_2-saturated distilled, deionized water equal to four times the mass of the soil. The CO_2-saturated water was most suitable for *Daphnia* assays because pH adjustments of resultant extracts were seldom necessary. The possibility of toxic effects from materials necessary to adjust the pH, under conventional TCLP, was eliminated. The samples were extracted in darkness for 48 hr at 30 rpm end-over-end. Extracts were filtered through 0.45-μm membrane filters, serially diluted, and used in 48-hr acute *Daphnia* toxicity assays. Metal and organic analyses were completed on each sample. Control samples of the same soil type as those at the OB/OD sites were located using extracts taken from the OB/OD sites and were toxic to *Daphnia*, having 48-hr acute EC0s ranging from 1.2069 percent (vol/vol).

National Technical Information Service (NTIS): AD-A270 410/4/XAB

Combustion/Control/*Daphnia*/Darkness/Detonations Filters/Leaching/ Maps/Mass/Membranes/Metals/Operations/Residues/Sites/Soil Surveys/ Toxicity/Water/Hazardous Materials/Contamination/Explosives/ Response.

Haley, M. V., and Kurnas, C. W. Toxicity and Fate Comparison between Several Brass and Titanium Dioxide Powders. Edgewood Research, Development and Engineering Center, Aberdeen Proving Ground, MD. 1993:13.
Brass flakes (MD Both Industries, Ashland, MA), SF150 Rich Gold, and four brands of titanium dioxide were tested to determine their toxicities to *Daphnia magna* (water flea), *Ankistrodesmus falcatus* (green algae), and *Selenastrum capricornutum* (green algae). The toxicity of the brass materials were ranked high, having EC50S below 1 mg/L for *Daphnia* and algae. The fate of the brass materials were determined in fresh water of varying hardness, in synthetic marine salt water (30 ppt), and in physiological saline solution (9 ppt). The titanium dioxide materials were nontoxic to *Daphnia* up to 1,000 mg/L. *Daphnia* were able to ingest titanium dioxide and pack the entire gut without showing any apparent effects.

National Technical Information Service (NTIS):A DA270 185/2/XAB

Algae/Brass/*Daphnia*/Dioxides/Fresh Water/Hardness/Saline Solution/ Salt Water/Salts/Siphonaptera/Titanium Dioxide/Toxicity/Water/ Comparison.

Haley, M. V., Kurnas, C. W., Chester, N. A., and Muse, W. T. Aquatic Toxicity of the Decontamination Agent: Multipurpose (DAM) Decontamination Solution. Giveth Reports Announcements & Index (GRA&I). 1994(19).
A new formulation, Decontaminating Agent: Multipurpose (DAM) Decontamination Solution, is being considered as a replacement to the DS2 decontaminating solution. The new formulation is composed of calcium hypochlorite and Ncyclohexyl-2-pyrrolidinone. Since this is a new formulation, little environmental data exist. To estimate potential impact to an aquatic environment, *Daphnia magna* and photo bacterium phosphoreum (aluminescent marine bacterium) were exposed to the DAM solution and to the individual components calcium hypochlorite and Ncyclohexyl- 2-pyrrolidinone. The toxicity of the DAM solution to *D. magna* and *P. phosphoreum* was 5,000 and 0.00053, respectively (highly toxic). The toxicity of calcium hypochlorite and Ncyclohexyl-2-pyrrolidinone to *Daphnia* was 0.04 mg/L (highly toxic) and 107 mg/L (moderately toxic), respectively.

National Technical Information Service (NTIS): 280 3799

Decontamination/Toxicity/Aquatic Organisms/Environmental Impact/ Defect Analysis/Marine Biology/Calcium/*Daphnia*/Hypochlorites/ Exposure (General)/Assaying/ Chlorine Compounds/Reduction/Solutions (Mixtures)/Siphonaptera/pH Factor/Liquid Chromatography/Gas Chromatography/Water Pollution Effects/Calcium Hypochlorite/Aquatic Toxicity.

Hartley, W. R. Evaluation of Selected Subacute Effects of the Nitrotoluene Group of Munitions Compounds on Fish and Potential Use in Aquatic Toxicity Evaluation. Tulane University, New Orleans, LA. School of Public Health and Tropical Medicine. 1981:223
Juvenile bluegills were exposed to 0.05, 0.50, 2.0, 4.0, and 8.0 mg/L 2,4-DNT for 8 weeks. Both first and second order growth constants indicated reduced growth rates with increasing 2,4-DNT concentration. The threshold concentration for significant growth rate reduction was 0.05 mg/L 2,4-DNT. No histological abnormalities were found in the digestive tract, pancreas, integument, heart, gonad, head kidney, and spinal cord. Significant histopathological responses were observed in liver, spleen, trunk kidney, lateral line, and gill fish exposed to 0.5 - 8.0 mg/L 2,4-DNT for 45-56 days. The 2,4-DNT was rapidly absorbed (24-96 hr),

reached relatively low bioconcentration levels, and was rapidly eliminated (24-72 hr) when fish were placed in 2,4-DNT free environment.

National Technical Information Service (NTIS): ADA101 829/0

Exposure(Physiology)/DNT/Toxic Agents/Osteichthyes/Sublethal Dosage/ Growth(General)/Tissue (Biology)/Liver Diseases/Cardiovascular Diseases/Spleen/Kidney Diseases/Fish Gills/Physiological Effects/ Bioassay/Laboratory Tests.

Hartwell, S. I., Jordahl, D. M., Evans, J. E., and May, E. B. Toxicity of Aircraft Deicer and Antiicer Solutions to Aquatic Organisms. Environmental Toxicology and Chemistry 1995; 14(8):1375-1386.
Laboratory studies were undertaken to assess the toxicity of industrial mixtures of aviation de-icers and anti-icers. Various additives and contaminants are present in these solutions at proportions of 10 to 20 percent of the total volume. Static renewal toxicity tests were performed at concentrations that bracketed published LC50 values for the primary ingredients (9-51 ml glycol/L) using fathead minnow (*Pimephales promelas), Daphnia magna, Daphnia pulex, Ceriodaphnia dubia*, and photo bacterium phosphoreum (Microtox registered) bioassays. Water from a stream that receives runoff from a large commercial airport was also tested during a late winter storm (March) and spring baseflow (April). The anti-icer solution was more toxic than the de-icer solution by two orders of magnitude (96-hr LC_{50} range 0.030.44 ml/L, 3.0213.48 ml/L, respectively). Both types of solutions exhibited greater toxicity than previously reported values for the primary ingredients. Toxic effects were observed in the March stream sample, but not the April sample. Significant inhibition of reproduction in *C. dubia* in the anti-icer and de-icer solutions occurred at 0.05 and 0.38 ml/L, respectively. Effects were observed in the Microtox assay at concentrations of 0.125 and 0.25 ml/L for the anti-icer and de-icer, respectively. Results suggest that the additives, rather than the glycols, are the major source of toxicity. Histological damage observed in fathead minnows primarily involved gill, kidney, and skin tissue, with the most prominent responses seen in fish exposed to the anti-icer solution. The de-icer solution elicited respiratory epithelial "disruption" and renal damage, and the anti-icer caused proliferative branchitis (hyperplastic response) and delamination of the epidermis from the dermis of the skin.

Water Resource Abstracts: 3785139

Aquatic Organisms/Industrial Pollution/Reproduction/*Ceriodaphnia dubia*/Glycol/Pollution Effects/Toxicity/Toxicity Tests/Sexual Reproduction/Synergism/Histology/Ice-Prevention/*Daphnia/Pimephales*

*promelas/*Photo Bacterium Phosphoreum/De-icing/Aircraft/De-icers/ Water Pollution Effects/Bioassay/Bioindicators/Fathead Minnows.

Hazardous Materials. **Danger Prop Ind Mater Report 1988 Jul-1988 Aug 31; 8(4):23(70).**
Toxicological data are compiled for bacitracin, butyl stearate, gallic acid, hydroxylamine, melamine, mercury nitrate, pyrethrin II, strontium chloride, tannic acid, terephthalic acid, thorium chloride, 2,4,6-trinitrotoluene, vanadium pentoxide, and zinc fluor borate. These hazardous materials are addressed with reference to common uses, gastrointestinal absorption and toxicity, aquatic toxicity, general environmental impacts, phytotoxicity, chemical hazard response information, and other toxicological data culled from the literature.

Enviro-line : 8900145

Chemical Residues/Chemical Usage/Pathology/Fish-Laboratory/ Pathology/Animal-Laboratory/Chemical Spills/Product Safety/ Decontamination/Carcinogenic Agents/Pathology/Plant-Laboratory.

Health and Environmental Effects Profile for Trinitrophenols Environmental Protection Agency, Cincinnati, OH. Environmental Criteria and Assessment Office. 1984 Jan:43.
The Health and Environmental Effects Profile for Trinitrophenols was prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH, for the Office of Solid Waste to support listings of hazardous constituents of a wide range of waste streams under Section 3001 of the Resource Conservation and Recovery Act (RCRA). Both published literature and information obtained from Agency program office files were evaluated as they pertained to potential human health, aquatic life, and environmental effects of hazardous waste constituents. Quantitative estimates have been presented provided sufficient data are available. Existing data are insufficient to determine an acceptable daily intake (ADI) or a carcinogenic potency factor for trinitrophenols.

National Technical Information Service (NTIS): PB88131081/XAB

Hazardous Materials/Environmental Surveys/Picric Acid/Exposure/ Carcinogens/Mutagen/Toxicity/Risks/Public health/Ecology/Transport Properties/Toxicology.

Hembree, S. C. U.S. Army Biomedical Research and Development Laboratory, Annual Progress Report FY 88. Army Biomedical

Research and Development Laboratory, Fort Detrick, MD. 1988 Oct 1; 2:180.
The Annual Progress Report, Fiscal Year 1988, summarizes in two volumes the research performed by the U.S. Army Biomedical Research and Development Laboratory in projects authorized by The Surgeon General, the Army, and the Commander, U.S. Army Medical Research and Development Command, and supported by RTDE funds from the U.S. Army Medical Research and Development Command. Project areas studied include aquatic toxicology, aquatic microcosm, biochemical toxicology, carcinogenicity research, toxin decontamination, biological warfare, vector control, toxicology, occupational health and exposure assessment, oncogene, environmental hazard assessment, photochemistry, environmental quality, pesticide dispersal, medical imaging, armored mobile aid, micro gravity, necrosis, core temperature measurement, combat medicine, chemical warfare, nerve agents, industrial hygiene sampling, microbiology, combustion products, liquid gun propellant, organic chemistry, inorganic chemistry, radiographs, field medical materiel, field sterilizers and sterilization, ecological effects, drinking water quality, weapons health and performance effects, film less radiography, and electromagnetic pulse.

National Technical Information Service (NTIS): ADA204 925/2/XAB

Army Research/Biological Warfare/Biomedicine/Hazards/Health/ Industrial Hygiene/Medical Equipment/Medical Research/Medical Services/Military Medicine/Microbiology/Toxicology/Toxins and Antitoxins/ Disease Vectors.

Hembree, S. C. U.S. Army Biomedical Research and Development Laboratory, Annual Progress Report FY 88. Army Biomedical Research and Development Laboratory, Fort Detrick, MD. 1988 Dec 21; 1:106.
The Annual Progress Report, Fiscal Year 1988, summarizes in two volumes the research performed by the U.S. Army Biomedical Research and Development Laboratory in projects authorized by the U.S. Army Surgeon General and the Commander, U.S. Army Medical Research and Development Command. This research was supported by RDTE funds from the U.S. Army Medical Research and Development Command, from the U.S. Army Corps of Engineers, and as reimbursables from several additional sources. Research areas covered in this report include aquatic toxicology, aquatic microcosm, biochemical toxicology, carcinogenicity research, toxin decontamination, biological warfare, vector control, toxicology, occupational, health and exposure assessment, oncogene, environmental hazard assessment, photochemistry, environmental quality, pesticide dispersal, medical imaging, armored mobile aid, micro gravity,

necrosis, core temperature measurement, combat medicine, chemical warfare, nerve agents, industrial hygiene sampling, microbiology, combustion products, liquid gun propellant, organic chemistry, inorganic chemistry, radiographs, field medical materiel, field sterilizers and sterilization, ecological effects, drinking water quality, weapons health and performance effects, film less radiography, and electromagnetic pulse.

National Technical Information Service (NTIS): ADA204 677/9/XAB

Aquatic Biology/Army Research/Biological Warfare/Biomedicine/ Exposure(Physiology)/Hazards/Health/Industrial Hygiene/Medical Equipment/Medical Research/Medicine/Microbiology/Military Medicine/ Toxicology/Toxins and Antitoxins/Disease Vectors.

Higashi, R. M., Cherr, G. N., and Crosby, D. G. The Efficacy of Enhanced Photo Oxidation for the Reduction of TOCl, Color, and Toxicity in Mill Aqueous Effluents. TAPPI 1991 Environ Conf, San Antonio, TX P73(11). 710 Apr:91.
The heterogeneous photo oxidation of bleached kraft mill effluent was evaluated, using UV light and titanium dioxide photocatalyst coupled with standard and nonstandard analyses for total organic chlorine (TOCl), color, and aquatic toxicity of effluent. When whole effluents were irradiated at 254 NM in the presence of the catalyst, pollutant degradation increased with elevated temperature, increased light intensity, and low pH. Aeration with oxygen maximized the degradation rate. The presence of TiO_2 contributed little to overall spectral degradation or loss of TOCl but was important in reducing toxicity and preventing the accumulation of chloroform.

Enviro-line : 9202246

Effluent Treatment/Photodegradation/Chlorine/Pulp/Mill Effluents/Color Removal/Wastewater Analysis/Ultraviolet Radiation/Biological/ Indicators/Water Chloroform/Titanium Dioxide/Catalysts Review Classification 19.

Jaffe, L. S., Tew, R. W., Burrows, D. W., and Dacre, J. C. Mammalian Toxicology and Toxicity to Aquatic Organisms of TNT, DNT, and Other Munitions Manufacturing Waste Constituents of Pink Water-A Literature Evaluation. George Washington University Washington, DC. 1973 Nov: 80.
Acutely toxic doses of TNT to mammals vary with species and route of administration, starting somewhere below 200 mg/kg. No LD50 values have been determined. Chronic doses in the range of 5-100 mg/kg cause anemia, hemolysis, and associated disorders in mammals. In man,

hematologic changes followed by such manifestations as toxic hepatitis, effects on the central nervous system, and, on extremely prolonged exposure, cataract formation. The order of magnitude for DNT toxicity is about that for TNT. No evidence has been found for mutagenic, carcinogenic, and teratogenic effects or for sensitization by TNT or DNT. The main TNT metabolite identified in biochemical studies is 4-amino2,6-dinitrotoluene. DNT appears to be somewhat less toxic to fish than TNT and "relatively nontoxic" to microorganisms.

National Technical Information Service (NTIS): AD777 903/6

Aquatic/Organisms/Toxicology/TNT/DNT/Explosives/Industries/Wastes/Ammunition/Humans/Mammals/Aquatic Animals/Dosage/Water Pollution.

Jenkins, D., Klein, S. A., and Cooper, R. C. Fish Toxicity of Jet Fuels: I. The Toxicity of the Synthetic Fuel JP-9 and Its Components. Water Res. 1977; 11:1059-1068.

The toxicity of the jet fuel JP-9 and its components RJ-4 (isomeric mixture of tetrahydromethylcyclopentadiene dimer), RJ-5 (isomeric mixture of tetrahydronorbornadiene dimer), and MCH (methyl cyclohexane) was assessed in static bioassays on the warm water fish, golden shiner (*Notemigonus crysoleucas*). The 96 hr LC_{50} of emulsions was 2.0 mg L^{-1} for JP9, 0.51 mg L^{-1} for RJ-4, 0.61 mg L^{-1} for RJ5, and 72 mg L^{-1} for MCH. As determined by the 96 hr LC_{50} values, unemulsified fuel (pools of fuel) JP-9 was 235 times less toxic; RJ-4 was 196 times less toxic; RJ-5 was 7,700 times less toxic; and MCH was 3.3 times less toxic than the corresponding emulsified materials. In continuous flow bioassays with the water soluble fraction of the fuel and its components, the effect on egg hatch ability and fry development of flagfish (*Jordanella floridae*) and rainbow trout (*Salmo gairdneri*) was studied. The no effect of level on flagfish egg hatch ability was 0.23 mg L^{-1} for JP-9 and 0.05 mg L^{-1} for RJ-5. Concentrations of 0.83 mg L^{-1} MCH and 0.2 mg L^{-1} RJ-4 did not affect egg hatch ability. In rainbow trout studies, 97-day LC_{50} values for RJ-4 and RJ-5 were 0.045 mg L^{-1} and 0.072 mg L^{-1}, respectively, and 23-day LC_{50} values for JP-9 and MCH were 0.26 mg L^{-1} and 1.3 mg L^{-1}, respectively. The accumulation of fuels in fish bodies was studied, and it was found that they can tolerate a total body burden of 0.5 mg MCH g^{-1} wet weight without lethality. Body burdens of 0.43 mg RJ-4 g^{-1} and of 0.27 mg RJ-5 g^{-1} on a wet weight basis will produce 50-percent mortality in rainbow trout. Voiding of MCH from fish bodies occurs readily in fuel free water, but RJ-4 and RJ-5 are retained in the tissues. (Jet fuels can be introduced into the environment and come in contact with aquatic biota in several ways.)

Engineering Information Monthly subfile: CHEMFILE; HEEP7809356

Johnson, D. W., Haley, M. V., Hart, G. S., Muse, W. T., and Landis, W. G. Acute Toxicity of Brass Particles to *Daphnia magna*. Journal of Applied Toxicology. 1986 Jun; 6(3):225-228.
The aquatic toxicity of brass particles was examined in acute, 48-hr bioassays using the water flea, *Daphnia magna*. Tests were conducted with uniform suspensions of uncoated brass particles, brass particles coated with Teflon solution, silica particles, and titanium dioxide particles. The Teflon coating solution and the supernatant of the brass suspension (after settling of the brass) also were tested. All tests were conducted according to guidelines set forth by the U.S. Environmental Protection Agency and the Organization for Economic Cooperation and Development. Mean EC_{50} determinations of 20.0 and 23.6 μm/L were calculated for uncoated and coated brass particles, respectively. The silica, titanium dioxide, and Teflon each have an EC_{50} > 1 g/L. Chemical fate studies demonstrated that the brass dissociated to its ionic components of copper and zinc quickly at pH 2.0. At pH 5.0 and 6.5, the dissociation occurred too slowly to account for the observed toxicity. The data suggest that the toxicity is due to filtration by the daphnids and ingestion. EC_{50} determinations for the brass particles are nearly identical with published EC_{50} values for copper salts.

Water Resource Abstract: 8700646

Toxicity/Aquatic Animals/*Daphnia*/Brass/Particulate Matter/Ecosystems/ Aquatic Insects/Copper/Zinc/Fate of Pollutants/Hydrogen-Ion Concentration.

Johnson, D. W., Haley, M. V., Hart, G. S., Muse, W. T., and Landis, W. G. Toxicity of Brass Particulate to *Daphnia magna*. Chemical Research and Development Center, Aberdeen Proving Ground, MD. 1985 Nov:15.
The aquatic toxicity of a brass particulate was examined. Acute, 48-hr bioassays were performed using the water flea, *Daphnia magna*. Tests were conducted with uniform suspensions of uncoated brass particulate, brass particulate coated with a Teflon solution, silica, and titanium dioxide. The Teflon coating solution and the supernatant of the brass suspension (after settling of the brass) also were tested. The effective concentrations that would be lethal to 50 percent of a population were calculated for uncoated (20.9 μm/L) and coated (23.6 μm/L) brass particulate. The silica, titanium dioxide, and Teflon each had an EC_{50} of >1 g/L. Chemical fate studies demonstrated that the brass dissociated to its ionic components of copper and zinc quickly at pH 2.0. At pH 5.0 and 6.5, the dissociation occurred too slowly to hypothesize that the observed

toxicity was due to the presence of copper ions. The data suggested that the toxicity is due to filtration by the daphnids and subsequent ingestion. EC_{50} determinations for the brass are nearly identical with published EC_{50} values for copper salts.

National Technical Information Service (NTIS): ADA163 035/9/XAB

Brass/Toxicity/Siphonaptera/Lethal Dosage/Filtration/Ingestion (Physiology)/Bioassay/Copper Compounds/Salts/Population/Coatings/ Solutions(General)/Tetrafluoroethylene Resins/Titanium Dioxide/ Particulates/Copper/Ions/Dissociation/Water/Zinc.

Kane, D. A., and Williamson, K. J. Bacterial Toxicity and Metabolism of Three Hydrazine Fuels. Oregon State University, Chervils. Department of Civil Engineering. 1980 Sep:118.
Hydrazine-based fuels are used for Titan and Minuteman missiles and the 16 aircraft and by the Space Shuttle Program. These uses represent significant production, transportation, and storage of these fuels, and, as such, a serious threat to the aquatic environment from the potential for accidental release. This research sought to determine the toxicity of hydrazine (H), monomethyl hydrazine (MMH), and unsymmetrical dimethyl hydrazine (UDMH) to four enriched bacterial cultures: Nitrobacter, Nitrosomonas Nitrobacter, anaerobic bacteria, and denitrifying bacteria. In addition, the metabolism of hydrazine by Nitrosomonas Nitrobacter was examined. The toxicity studies used batch bioassay methods with response measured in terms of substrate metabolism rates. Results showed that hydrazine produced a 50-percent reduction in metabolism rate for Nitrobacter, Nitrosomonas Nitrobacker, anaerobic bacteria, and denitrifying bacteria at concentrations of about 15,165, 100, and 100 mg/L, respectively; monomethyl hydrazine at 15, <1, 75, and 10 mg/L, respectively; and UDMH at 1,800, 35, 2,300, and 12,500 mg/L, respectively. It was concluded that spills of these three fuels could be expected to seriously disrupt the natural bacterial balance in the aquatic environment. In addition, use of biological waste treatment for detoxification of these three fuels is not recommended.

National Technical Information Service (NTIS): ADA099 514/2

Toxicity/Hydrazine/Fuels/Methyl Hydrazines/Dimethyl Hydrazine/ Metabolism/Bacteria/Biodeterioration/Jet Engine Fuels/Liquid Rocket Fuels/Response(Biology)/Degradation/Acclimatization/Bioassay/ Anaerobic Bacteria/Physical Properties/Tables(Data) Detoxification/ Colonies(Biology)/Inhibition/Rates/Gases/Chemical Analysis/Recovery.

Kenyon, K. F. Data Base Assessment of Environmental Fate Aspects of Nitroguanidine. Army Medical Bioengineering Research and Development Laboratory, Fort Detrick, MD. 1982 Dec:20.
This report is a current assessment of the database available for nitroguanidine, a component of U.S. Army triple-base propellant mixtures. Nitroguanidine is scheduled for production at Sunflower Army Ammunition Plant, DeSoto, KS. Sufficient gaps exist in the data available on the environmental fate and aquatic and mammalian toxicity of nitroguanidine to warrant further studies. Data describing physical transport of nitroguanidine are totally lacking. Although solubility of nitroguanidine is well known, no experimental information is available for the octanol-water partition coefficient (estimated K02 = 2.7) and bioconcentration in aquatic species. Hydrolysis rates of nitroguanidine in natural water are not known. Photolysis in natural waters where humics and suspended solids are present must be measured. Other chemical transformations, including oxidation/reduction, will have to be screened and measured. Nitroguanidine is capable of being anaerobically biodegraded; however, whether or not microorganisms indigenous to the creeks receiving nitroguanidine effluents can also degrade the compound, and if so, at what rate, needs to be determined. It is not known if water plants will take up nitroguanidine. More data are required to precisely assess the hazard of nitroguanidine to mammalian and aquatic species.

National Technical Information Service (NTIS): ADA125 591/8

Nitroguanidine/Environmental Impact/Toxicity/Pollutants/Databases/ Propellants/Hazardous Materials/Waste Water/Water Pollution/Aquatic Organisms/Mammals/Biodeterioration/ Carcinogenesis/Hydrolysis/ Nitroso Compounds/Photolysis/Transport/Properties/Solubility/ Concentration(Chemistry).

Klein, S. A., and Jenkins, D. Toxicity of Jet Fuels to Fish II The Toxicity of JP-8 to Flagfish (*Jordanella floridae*) and Rainbow Trout (*Salmo gairdneri*) and Golden Shiners (*Notemigonus chysoleucas*). Water Research. 1983; 17(10):1213-1220.
JP-8 is a widely used commercial and military jet fuel that may reach the aquatic environment by several avenues. JP-8 is a kerosene based aviation fuel that consists of a complex mixture of aliphatic and aromatic hydrocarbons and is similar to the commercial aviation fuel Jet A-1. The major difference is that JP-8 contains ethylene glycol monomethyl ether. The toxicity of JP-8 to cold and warm water fish was investigated to help define the impact on fresh water species. Fish were exposed to the water soluble fraction (WSF) of JP-8 in static acute bioassays and continuous-flow bioassays of approximately 4 months duration. The goal was to determine the 96-hr LC_{50} and the long-term no-effect level on the life

cycle. The acute toxicity to golden shiner, a warm water fish, was found to be unaffected by pH in the range of 7.3-9.1. Flagfish growth was not affected by the presence of 1.7 mg/L WSF of JP-8, but the no-effect level on rainbow trout was <1.4 mg/L (the lowest level tested). Neither lethality nor egg hatching was a conclusive indicator of species sensitivity to the WSF of JP8. Accumulation of fuel in tissues does not explain the greater toxicity of WSF of JP-8 to rainbow trout over its toxicity to flagfish. The accumulation ratio in flagfish is double that of trout. Depuration from flagfish is fairly rapid (90 percent in 14 days). Accumulation of JP-8 in fish tissue occurred at all aqueous fuel concentrations tested, so the presence of even very low levels of fuel in a body of water would cause off tastes and flavors in fish.

Water Resource Abstracts: 8402175

Fuel/Water Pollution Effects/Toxicity/Trout/Flagfish/Shiners/Water Soluble Fraction/Bioassay/Growth/Hatching/Mortality/Bioaccumulation/ Depuration/JP.

Larsson, P., Thuren, A., and Gahnstrom, G. Phthalate Esters Inhibit Microbial Activity in Aquatic Sediments. Environ Pollut Ser a Ecol Biol. 1986; 42:223-232.
Ecology/Environmental Biology-Limnology/Biochemistry-Gases (1970)/ Biochemical Studies-General/Metabolism-Energy/Respiratory Metabolism/Toxicology-Environmental/Industrial Toxicology/Public Health/Environmental Health-Air/Water/Soil Pollution/Soil Microbiology/ Soil Science-Physics/Chemistry (1970)/Air Pollution/Soil Pollutants/ Water Pollution/Ecology/Fresh Water/Gases/Biochemistry/Energy Metabolism/Respiration/Environmental/Pollutants--Poisoning/ Occupational Diseases/Soil Microbiology/Soil.

BIOSIS: 8701327

Di-2-ethylhexylphthalate Oxygen Consumption

Layton, D., Mallon, B., Mitchell, W., Hall, L., and Fish, R. Conventional Weapons Demilitarization: A Health and Environmental Effects Base Assessment. Phase 2. Explosives and Their Cocontaminants. Lawrence Livermore National Laboratory, CA. Environmental Sciences Div. 1987 Dec:427.
The demilitarization of conventional explosives by open burning and open detonation results in the deposition of residues in soils. Cocontaminants, consisting of impurities present in explosives along with operations have occurred. To support studies of the health and environmental risks of such byproducts, this report presents assessments of data available on

parameters that affect the risks posed by explosives and their principal cocontaminants. Specifically, database assessments cover factors that influence the transport and fate of the contaminants in environmental media (e.g., soils and water) and subsequently, human exposures via different pathways (e.g., inhalation, ingestion, and skin absorption). Importantly, information on dose response relationships for various toxic effects in humans and laboratory animals is evaluated so that acceptable daily intakes for noncarcinogenic substances and virtually safe dose rates for carcinogenic substances can be defined. Toxic effects on plant and aquatic species are also addressed. The explosives and cocontaminants considered include TNT (cocontaminants: 2,4-dinitrotoluene; 2,6-dinitrotoluene, 1,3-dinitrobenzene, 1,3,5-trinitrobenzene, 2-amino-4,6-dinitrotoluene); RDX (cocontaminant: HMX); tetryl (cocontaminant: picric acid); PETN; and ammonium picrate (cocontaminant: picric acid).

National Technical Information Service (NTIS): ADA220 588/8/XAB

Absorption/Ammonium Picrate/Carcinogens/Contamination/Explosive Ordnance Disposal/Databases/Demilitarization/Deposition/Dosage/Dose Rate/Environments/Environmental Hazards/Explosives/Exposure (Physiology)/Hazards/HMX/Human Body/ Humans/Impurities/Inhalation/ Laboratory Animals Media/PETN/Picric Acid/RDX/Residues/Response (Biology)/Safety/Soil Contamination\Soils/Test and Evaluation/Tetryl/ TNT/Toxicity/Water/Weapons.

LeBlanc, G. A., Schoenfeld, D. A., Surprenant, D. C., and Bentley, R. E. Determination of the Toxicity to Aquatic Organisms of HMX and Related Wastewater Constituents. Part 1. The Effects of Food Concentration, Animal Interactions and Water Volume on Survival Growth and Reproduction of *Daphnia magna* under Flow-Through Conditions. EG and G Bionomics, Wareham, MA. 1983 Jan:43.
The purpose of this study was to evaluate the effects of food concentration, animal interaction, and water volume on survival, growth, and reproduction of *Daphnia magna* under flow-through conditions. A response surface design was used to determine the interactive, as well as the individual, effects of the three factors. Results indicated that there was no important interactive effects of the three factors on survival, growth, or reproduction of *D. magna*. Individual effects of the factors on reproduction were observed. Food concentration produced a linear trend with increasing food resulting in an increase in offspring production. The number of daphnids per container produced a quadratic trend with the maximum offspring production occurring in vessels containing approximately 14 daphnids. Water volume produced a slight linear trend with increasing water volume resulting in an increase in offspring production.

National Technical Information Service (NTIS): ADA148 568/9/XAB

Daphnia/HMX/Waste Water/Toxicity/Reproduction/Aquatic Organisms/ Survival(General)/Food/Interactions/Growth(General)/Volume/Water.

LeBlanc, G. A., Surprenant, D. C., Bentley, R. E., and Petrocelli, S. R. Determination of the Toxicity to Aquatic Organisms of HMX and Related Wastewater Constituents. Part 2. The Acute and Chronic Toxicity of Acetone, Dimethyl Formamide and Triethylene Glycol to *Daphnia magna* (Straus). EG and G Bionomics, Wareham, MA. 1983 Jan:47.

Acute and chronic toxicity tests were performed with three organic solvents commonly used to facilitate the solubilization of lipophilic compounds during aquatic toxicity tests with *Daphnia magna* (Straus). The 48-hr LC_{50} values and corresponding 95-percent confidence intervals were acetone, 39,000(3100053000) μL/L; dimethyl Formamide, 13,000 (1000016000) μL/L; triethylene glycol, 35,000(2800046000) μL/L. Maximum acceptable toxicant concentrations determined during the chronic toxicity tests were acetone, >1,400<2,800 μL/L; dimethyl formamide, >1,200<2,500 μL/L; triethylene glycol, >5,500<11,000 μL/L. Triethylene glycol was the least chronically toxic solvent and is recommended as the primary choice when selecting a carrier solvent during aquatic toxicity tests. All three solvents were sufficiently low in toxicity to suggest that the recommended usage limits acute toxicity tests, 100 μL/L during long-term toxicity tests, are adequate for the prevention of solvent related toxicity to *D. magna*.

National Technical Information Service (NTIS): ADA148 569/7/XAB

Toxicity/HMX/Acetone/Organic Solvents/Aquatic/Organisms/Waste Water/Ethylene Glycol/Test Methods/Water Quality/Identifiers/Acetone/ Formamide/Dimethyl/Triethylene Glycol.

Liu, D. H. W., Spanggord, R. J., Bailey, H. C., Javitz, H. S., and Jones, D. C. L. Toxicity of TNT Wastewaters to Aquatic Organisms. Volume 1. Acute Toxicity of LAP (Load, Assemble, and Pack) Wastewater and 2,4,6-Trinitrotoluene. SRI International, Menlo Park, CA. 1983 Mar; See also Volume 2:85.

The acute toxicity to aquatic organisms of Composition B (COMP B) type LAP wastewater was determined. The tests were performed primarily on a 1.6 to 1 mixture of TNT and RDX, which are the major organic components of the wastewater and which are normally present in a 1.6:1 ratio in untreated wastewater. Acute toxicity tests were also performed on TNT and RDX and on 2,4,6-trinitrobenzaldehyde, 2,4,6-trinitrobenzonitrile, 1,3,5-trinitrobenzene, and 4,6-dinitroanthranil, which

are photo transformation products of TNT and RDX. All of these tests were conducted to obtain an initial assessment of the potential hazard of LAP wastewater to aquatic life. Exposure of LAP wastewater, TNT, and the TNT-RDX mixture to filtered UV light (simulated sunlight) reduced their toxicity by a factor of up to 25. The toxicity of these materials decreased as the photolytic degradation of TNT increased. The photo transformation products of TNT were generally more toxic than TNT; however, there is evidence that when TNT photolyzes, the concentrations of the photo products do not reach lethal levels.

National Technical Information Service (NTIS): ADA142 144/5

Toxicity/TNT/RDX/Waste Water/Aquatic Organisms/Mixtures/ Ultraviolet Radiation/Degradation/Photolysis/pH Factor.

Liu, D. H. W., Spanggord, R. J., Bailey, H. C., Javitz, H. S., and Jones, D. C. L. Toxicity of TNT Wastewaters to Aquatic Organisms. Volume 2. Acute Toxicity of Condensate Wastewater and 2,4-Dinitrotoluene. SRI International, Menlo Park, CA. 1983 Mar; See also Volume 1:70.

Condensate wastewater is a distillation product of red water, which is produced at U.S. Army ammunition plants during the continuous manufacture of 2,4,6-trinitrotoluene (TNT). Condensate wastewater is composed primarily of nitroaromatic byproducts of TNT manufacture. At least 30 organic compounds have been identified in the wastewater that are attributable to TNT production. The major component is 2,4-dinitrotoluene (DNT). Acute toxicity tests on red water, condensate wastewater, and 2,4-DNT produced 96-hr LC_{50}s of 360 and 185 mg/L as total dissolved solids for red water and condensate wastewater, respectively, and 31.4 mg/L for 2,4-DNT in fathead minnows (*Pimephales promelas*). Exposure of condensate wastewater and 2,4-DNT to filtered UV light reduced their acute toxicity by a factor of 2, but the same treatment did not affect the acute toxicity of red water. Benzene extracts of red water and condensate wastewater were more toxic than the remaining aqueous fractions. This suggested that the nonpolar components contribute more to the toxicity of these wastewaters than the polar components. Acute toxicity tests performed on 30 of the organic components of condensate wastewater revealed two with 96-hr LC_{50}s of less than 1.0 mg/L in fathead minnows.

National Technical Information Service (NTIS): ADA142 145/2

Toxicity/TNT/RDX/Waste Water/Aquatic Organisms/Mixtures/ Ultraviolet Radiation/Degradation/Photolysis/pH Factor.

Liu, D. H. W., Spanggord, R. J., and Bailey, H. C. Toxicity of TNT Wastewater (Pink Water) to Aquatic Organisms. Stanford Research Institute, Menlo Park, Calif. 1976 Jan:29.
The acute toxicity was determined of aqueous solutions of TNT and 2,4-DNT and three types of TNT wastewater from the Joliet Army Ammunition Plant to the fathead minnow (*Pimephales promelas*) and the aquatic invertebrate *Daphnia magna*. The toxicity tests were conducted on materials that had been adjusted to pH 5, 7, and 9.4 and exposed to ultraviolet light. All tests were conducted under static conditions without aeration. The pH of the material during irradiation had little effect on its toxicity. Ultraviolet irradiation of LAP and condensate wastewater and of alpha TNT and 2,4-DNT reduced their toxicity. The acute toxicity of benzene and aqueous fractions of nonirradiated wastewater and of 50 percent photolyzed aqueous solutions of alpha-TNT and 2,4-DNT was also determined. The benzene were more toxic than the aqueous fractions. Evidence was obtained suggesting that alpha-TNT is probably the most toxic ingredient of LAP wastewater. The minnow and *Daphnia magna* were equally sensitive to 2,4-DNT, but the latter was more tolerant of alpha-TNT.

National Technical Information Service (NTIS): ADA031 067/2

TNT/Water Pollution/Munitions Industry/Waste Water/Aquatic Organisms/Toxicity/Photo Dissociation/pH Factor/Fishes/Ultraviolet Radiation/Invertebrates/Lethal Dosage.

Machova, J., Hanzalova, J., Svobodova, Z., and Faina, R. Akutni toxicity prumyslovych vybusnin pro vybrane vodni organismy Acute toxicity of commercial explosive to selected aquatic organisms. Bul. Vyzk. Ryb. Hydrobiol. Vodnany. 1984; 20:35-42.
The commercial explosives subjected to study included trinitrotoluene (TNT), Infernit 45, Pernon Extra 9, Permonex V 19, Semtex 1A, and NcTp. The LC_{50} and LC_5 values of the explosives to which the studied aquatic organisms were exposed for 48 hr are given.

Explosives/Toxicity Tests/Toxicity Tolerance/Aquatic Animals/ Freshwater Fish.

Mayer, F. L., Jr., and Sanders, H. O. Toxicology of Phthalicacid Esters in Aquatic Organisms. Environ Health Perspect. 1973:153-157.
The low degree of toxicity and the high excretion rate of di-n-butyl and di-2-ethylhexyl phthalates might suggest that these compounds would be relatively safe as far as aquatic organisms are concerned; however, present data indicate that they can be detrimental to the reproduction of aquatic organisms at low chronic concentrations. The concentrations of phthalic

acid esters presently found in United States waters are, in some cases, detrimental to fish and aquatic invertebrates in view of laboratory results. Phthalic acid esters are produced in large amounts; they are in wide use as plasticizers; and they are entering aquatic ecosystems. Thus, these compounds should be considered as environmental pollutants. A more detailed evaluation of toxicological effects of phthalic acid esters is needed to elucidate their impact on aquatic ecosystems.

TOXLINE Subfile HEEP: 7311181

Mayer, F., Jr., Sanders, H. O., and Walsh, D. F. Toxicity, Residue Dynamics, and Reproductive Effects of Phthalate Esters in Aquatic Invertebrates. Environ. Res. 1973; 6:84-90.
Aquatic invertebrates were exposed to dinbutyl and di-2-ethylhexyl phthalate esters in water to determine toxicity, accumulation, and reproductive effect of these compounds. The acute toxicities were low and ranged from 2.1 mg/liter to greater than 32/liter. Residue accumulation was rapid resulting in body residues 70-13,600 times that of the water concentration. Phthalate residues were essentially gone after 10 days in fresh water. A reproductive impairment of 60 percent occurred in *Daphnia magna* exposed continuously to 3 μg/liter of di2ethylhexyl phthalate. (Author abstract reprinted by permission of Academic Press)

TOXLINE Subfile HAPAB: 7301922

McLellan, W. L., Hartley, W. R., and Brower, M. E. Hexahydro1,35-Trinitro-1,3,5-Triazine (RDX). Drinking Water Health Advisory: Munitions. Lewis Publishers, Boca Raton, FL. 1992:133-180.
Hexahydro1,3,5-trinitro-1,3,5-triazine, an explosive polynitramine is commonly known as RDX. It has been used extensively as a high impact explosive in military munitions in formulations since World War II. RDX is also used as a rat poison. Due to its low solubility in water (7.6 mg/L at 25 °C and 1.3 g/L at 83 °C), much of the RDX detected in wastewater consists of undissolved particulates. In experimental studies on the migration of 14-C-RDX in soils of various pH, texture, and organic matter typically found in the United States, RDX was associated with a downward movement and a very low leachate level (<0.5 ppm, which was the level of detection). In activated sludge systems, 97 percent of a 20-mg/L solution of RDX was degraded in 5 days. Sediment absorption will not lead to a significant loss in the aquatic environment. The degradation of RDX using ultraviolet radiation, hydrogen peroxide addition, and ultrasound cavitation has been studied. Hydrogen peroxide alone had no effect on munitions degradation. Similarly, ultrasound cavitational processes yielded no benefit when used alone or when combined with other treatments. Hydrogen peroxide applied at initial

concentrations of <0.01 percent enhanced RDX decomposition by ultraviolet photolysis. During treatment with UV radiation in combination with 0.01-percent hydrogen peroxide, RDX (18.9 mg/L) was degraded rapidly; the half-life was 8.0 min. The longer term health advisory (HA) for a 10-kg child has been determined to be 0.1 mg/L. In the absence of adequate data, the longer term HA for a 10-kg child is also used as a conservative estimate of the 1-day or 10-day HA. The longer term HA for a 70-kg adult was determined to be 0.4 mg/L. Based on previous studies, RDX is classified as group C: possible human carcinogen.

Water Resource Abstracts: 9305271

Health Advisory/Hexahydrotrinitro Triazine/Munitions Wastes/Standards/ Toxicity/Toxicology/Wastewater Treatment/Water Pollution Effects/ Activated Sludge/Carcinogens/Drinking Water/Leachates/Military Reservations/Path of Pollutants/Public Health/Regulations/Sediment Contamination/Soil Contamination/Water Pollution Control.

McLellan, W. L., Hartley, W. R., and Brower, M. E. Octahydro1,3,5,7-Tetranitro-1,3,5,7-Tetrazocine (HMX). Drinking Water Health Advisory: Munitions. Lewis Publishers, Boca Raton, FL. 1992:247-273.

Cyclotetramethylenetetranitramine, or Octahydro-1,3,5,7-Tetranitro-1,3,5,7-tetrazocine, is an explosive polynitramine commonly known as HMX (derived from high melting explosive). HMX, a colorless, crystalline solid, is a completely nitrated, eight-member heterocyclic ring compound. HMX is manufactured in the United States at the Holston Army Ammunition Plant (Alabama). Wastewaters resulting from manufacture and loading of HMX may be discharged into the environment and may present a potential for aquatic pollution. Sediment deposits in Army ammunition plants may also pose an environmental problem because such deposits may seep into the groundwater. Photolysis has been identified as the dominant fate process for HMX in the aquatic environment, with biotransformation also identified as important. Aerobic biotransformation of HMX occurs rapidly in HMX waste stream waters but not in river or lagoon waters. However, when supplementary organic material (yeast extract) was added to a 4-ppm concentration of HMX in river waters, a reduction to <0.1 ppm in 3 days was observed. Anaerobic biotransformation occurs very slowly but is accelerated in the presence of extra organic nutrients. The degradation of HMX was studied using UV radiation, hydrogen peroxide addition, and ultrasound cavitation. Hydrogen peroxide alone had no effect on munitions degradation. Similarly, ultrasound cavitational processes yielded no benefit when used alone or when combined with other treatments. Hydrogen peroxide applied at initial concentrations <0.01 percent enhanced RDX decomposition by

UV photolysis. During treatment with UV radiation in combination with 0.01 percent hydrogen peroxide, HMX was degraded rapidly. Based on the adverse hepatic and renal effects in rats administered HMX in the diet for 13 wks, the 1-day, 10-day, and longer term health advisory HA for exposure in a 10-kg child has been determined to be 5 mg/L; the longer term exposure in a 70-kg adult was determined to be 20 mg/L.

Water Resource Abstracts: 9305274

Health Advisory/Munitions Wastes/Octahydrotetranitro Tetrazocine/ Standards/Toxicity/Wastewater Treatment/Water Pollution Effects/ Alabama/Drinking Water/Groundwater Pollution/Holston Army Ammunition Plant/Military Reservations/Path of Pollutants/Public Health/Regulations/Water Pollution Control.

Means, J. C., Daniels, C. B., and Baksi, S. M. Development of In vivo Genotoxicity Tests in Estuarine Fish and Their Application to Aquatic Toxicology. Marine Environmental Research. 1988; 24:327-331.
Genotoxicity assays were developed in embryonic stages of two species of fish, striped bass (*Morone saxitilis*), and sheepshead minnow (*Cyprinodon variegatus*), and in the adults of *Fundulus heteroclitus* using metaphase chromosome aberrations as the end point. Dose-dependent responses were obtained with several chemical mutagen, including
9-amino acridine, ethyl methane sulphonate, cyclophosphamide and
n-methyl -n-nitro -nnitro-guanidine, added to estuarine water at doses spanning several orders of magnitude in compound concentration. Exposures ranged from 1 to 4 days; however, 2-day exposure time was found to be optimal in eggs and larvae. Tissues from the gills, kidney, and intestinal tract of adult *Fundulus* were found to be responsive to mutagen exposure; however, the intestine gave the best responses. The results of these experiments suggest that these assays are sufficiently sensitive to be used in the field as well as in laboratory tests.

National Technical Information Service (NTIS): PB90147695/XAB

Toxicology/Marine Fishes/In Vivo Analysis/Cyclophosphamide/ Exposure/Mutagen/Kidney/Liver/Gastrointestinal System/Estuaries/ Reprints.

Nay, M. W., Jr., Randall, C. W., and King, P. H. Biological Treatability of Trinitrotoluene Manufacturing Wastewater. Water Pollution Control Federation. 1974; 46:485-497.
A recent innovation in trinitrotoluene manufacturing has been the development of the countercurrent, continuous flow process. The new continuous process recycles many of the raw components to ensure full

use of their chemical potentials, and the wastewater from this process is more amenable to biological treatment. Biodegradability of trinitrotoluene wastewater was demonstrated using dynamic biochemical oxygen demand testing.

Ei Compendex (R): EI7406034203

Industrial Wastes/Treatment/Chemical Plants/Wastes.

Pearson, J. G., Robinson, P. F., and Bender, E. S. The Toxicity of Phossy Water to Selected Freshwater Organisms. Army Armament Research and Development Command, Aberdeen Proving Ground, MD, Chemical Systems Laboratory. 1978 Mar:15.
Six species of freshwater organisms were exposed to the wastewater from a white phosphorus munitions filling facility, Pine Bluff Arsenal, Pine Bluff, AR, in stated toxicity tests. Both fish (*Gambusia affins* and *Lepomis macrohirus*) and benthic macro invertebrates (*Glyptotendipes* sp., *Palaemonetes kadiakensis, Chaoborus punctipennis,* and *Branchiura sowerbyi*), endemic to the area, were tested for periods of up to 96 hr. The median effective concentration (EC_{50}) for all the invertebrates was between the LC_{50} for the bluegill (*L. macrochirus*, 29.0 μg/L P4) and the mosquito fish (G. *affinis*, 75 μg/L P4).

National Technical Information Service (NTIS): ADA054 374/4

Water Quality/White Phosphorus/Toxicity/Fishes/Invertebrates/Waste Water/Munitions Industry/Military Facilities/Arkansas/Fresh Water.

Pederson, G. L. Evaluation of Toxicity of Selected TNT Wastes on Fish, Phase I Acute Toxicity of Alpha TNT to Bluegills, 1 January 1970-31 October 1970. Army Environmental Hygiene Agency, Edgewood Arsenal, MD. 1970.
The acute toxicity of alpha-TNT (2,4,6-trinitrotoluene) to bluegills was determined relative to variations in water temperature or in water hardness. Ninety-six hour LC-50 values ranged from 2.3 to 2.8 mg/L of alpha TNT. Water temperature significantly affected the toxicity of alpha-TNT, i.e., lower concentrations were required to elicit toxicity at 10 °C rather than at 25 °C. Water hardness had no apparent effect.

Water Resource Abstracts: 7208443

Water Pollution Effects/Lethal Limit/Sunfishes/Nitrates/Nitrites/Toxicity/ Bioassay/Water Pollution Sources/Water Quality/Aquatic Animals/Fish/ Freshwater Fish/Inorganic Compounds/Pollutants/TNT/Trinitrotoluene.

Pederson, G. L. Sanitary Engineering Special Study No. 2400770/71. Evaluation of Toxicity of Selected TNT Wastes on Fish. Phase I. Acute Toxicity. Army Environmental Hygiene Agency, Edgewood Arsenal, MD. 1970 Oct 31:40.
The special study was conducted to determine the acute toxicity of alpha-TNT to bluegills and to determine if water temperature or hardness affected the toxicity level. Results (LC_{50}s) ranged from 2.3 - 2.8 mg/L of alpha-TNT for the different test conditions. It was found that temperature significantly affected the toxicity of alpha TNT, while hardness did not. It is recommended that additional acute toxicity studies be performed on a different fish species, on a higher aquatic invertebrate, and on an algal species.

National Technical Information Service (NTIS): AD725 572

TNT/Toxicity/Fishes/Toxic Tolerances/Water/Pollution/TNT/Marine Biology/Water/Temperature/Hardness/Aquatic Animals/Algae/Explosive Materials/Chemical Contamination.

Perwak, J., Goyer, M., Schimke, G., Eschenroeder, A., and Fiksel, J. Exposure and Risk Assessment for Phthalate Esters (Di(2-Ethylhexyl) Phthalate, Di-n-Butyl Phthalate, Dimethyl Phthalate, Diethyl Phthalate, Di-n-Octyl Phthalate, Butyl Benzyl Phthalate) (Revised). Giveth Reports Announcements & Index (GRA&I). 1985(19).
TD3: This report assesses the risk of exposure to di(2ethylhexyl) phthalate, di-n-butyl phthalate, dimethyl phthalate, diethyl phthalate, di-n-octyl phthalate, and butyl benzyl phthalate. This study is part of a program to identify the sources of and evaluate exposure to 129 priority pollutants. The analysis is based on available information from government, industry, and technical publications assembled in May of 1981. The assessment includes an identification of releases to the environment during production, use, or disposal of the substance. In addition, the fate of phthalate esters in the environment is considered; ambient levels to which various populations of humans and aquatic life are exposed are reported. Exposure levels are estimated, and available data on toxicity are presented and interpreted. Information concerning all of these topics is combined in an assessment of the risks of exposure to phthalate esters for various subpopulations.

National Technical Information Service (NTIS): 85211936

Risk/Hazardous Materials/Industrial Hygiene/Toxicology/Environmental Surveys/Phthalates/Public Health/Phthalic Acid/Bis(Ethylhexyl-Ester)/ Phthalic Acid/(Dibutyl-Ester)/Phthalic Acid/(Dimethyl-Ester)/Phthalic

Acid/(Diethyl-Ester)/Water Pollution Effects(Humans)/Occupational Safety/Health/Toxic Substances/Environmental Health.

Peters, G. T., Burton, D. T., Paulson, R. L., and Turley, S. D. Acute and Chronic Toxicity of Hexahydro-1,3,5-Trinitro-1,3,5-Triazine (RDX) to Three Freshwater Invertebrates. Environmental Toxicology and Chemistry. 1994; 10:1073-1081.
The acute and chronic toxicities of hexahydro-1,3,5-trinitro -1,3,5-triazine (RDX) to a daphnid *(Ceriodaphnia dubia*), a hydra (*Hydra littoralis*), and a midge *(Paratanytarsus parthenogeneticus*) were examined. RDX concentrations at the solubility limit of the compound under specific test conditions (17.0 mg RDX/L, *Ceriodaphnia dubia* at 25 °C; 32.3 mg RDX/L, *Hydra littoralis* at 22 °C; and 29.2 mg RDX/L, *Paratanytarsus parthenogeneticus* at 22 °C) were not acutely toxic to any of the three tested invertebrates. In a 7-day survival and reproduction test with *Ceriodaphnia dubia*, RDX caused no significant effect on survival, but reduced reproductive success. The no-observed-effect concentration, lowest observed-effect concentration, and chronic value for *Ceriodaphnia dubia* were 3.64, 6.01, and 4.68 mg/L, respectively. In an egg-to-egg life cycle test with *Paratanytarsus parthenogeneticus*, survival, growth, egg production, and hatching success were unaffected by RDX. Although not statistically significant, reductions in emergence success were observed at concentrations as low as 6.78 mg/L.

National Technical Information Service (NTIS): ADA284 144/3

Invertebrates/Toxicity/Fresh Water/Cycles/Diptera/Eggs/Life Cycles/ Production/Reproduction/Solubility/Test and Evaluation/Triazines/Value/ Isopoda/Exposure(Physiology)/Reprints.

Poston, T. M., McFadden, K. M., Bean, R. M., Clark, M. L., and Thomas, B. L. Acute Toxicity of Smoke Screen Materials to Aquatic Organisms, White Phosphorus-Felt, Red Phosphorus-Butyl Rubber and SGF No. 2 Fog Oil. Final Report. Battelle Pacific Northwest Laboratories, Richland, WA. 1986 Apr:167.
The acute toxicity of three obscurants was determined for nine freshwater organisms. The materials tested were white phosphorus-felt smoke, red phosphorus-butyl rubber (RPBR) smoke, and smoke generator fuel (SGF) No. 2 fog oil (bulk and vaporized). The chemistry of WP-F and RP-BR smoke in water and the resulting effects on aquatic organisms are similar. Combustion of these two obscurants and their deposition in water leads to the formation of many complex oxyphosphoric acids. Rates of hydrolysis of these complex products to ortho-phosphate were inconsistent and unpredictable over time. These products acidify water and produce toxic effects after exhausting the buffering capacity of the water. Acute 96-hr

tests using *Daphnia magna* with neutralized and nonneutralized exposure solutions indicated that the presence of unidentified toxic component(s) acted independently of pH. At pH levels of 6.0 to 7.0, phosphorus combustion products precipitated out of solution leading to a bimodal toxic response in extended 96-hr tests with *Daphnia magna*. Most components of fog oil had low solubility in water. Saturation was apparent at approximately 0.1 to 0.3 mg/L total oil. Vaporization had no demonstrable effect on the chemistry or toxicity of the fog oil. Neither the bulk fog oil nor the vaporized fog oil was acutely toxic to freshwater animals at concentrations less than 10 mg/L total oil. In oil-water mixes in excess of 1.0 mg/L total oil, fog oil quickly separated and floated to the surface. The primary hazard associated with vaporized and bulk fog oil was the physical effect of oil fouling the organisms. Photolysis increased the concentration of water soluble components of the fog oil. Acute toxicity was demonstrated in oil water mixes (approximately 10 mg/L total oil) of photolyzed bulk and vaporized oil. No difference in toxicity was observed between photolyzed and nonphotolyzed dilutions of OWM at comparable levels of total oil.

National Technical Information Service (NTIS): DE86010450/XAB

Aerosols/Smokes/Acute Exposure/Algae/Aquatic Organisms/Combustion Products/*Daphnia*/Experimental Data/Fishes/Fuel Oils/pH Value/ Phosphoric Acid/Phosphorus/Solubility/Toxicity/Water Chemistry.

Poston, T. M., McFadden, K. M., Bean, R. M., Clark, M. L., and Thomas, B. L. Acute Toxicity of Smoke Screen Materials to Aquatic Organisms, White Phosphorus-Felt, Red Phosphorus-Butyl Rubber and SGF (Smoke Generator Fuel) No. 2 Fog Oil. Battelle Pacific Northwest Laboratories, Richland, WA. 1986 Apr:168.
The acute toxicity of three obscurants was determined for nine freshwater organisms. The materials tested were white phosphorus-felt smoke, red phosphorus-butyl rubber (RPBR) smoke, and smoke generator fuel (SGF) No. 2 fog oil (bulk and vaporized). The chemistry of WPF and RPBR smoke in water and the resulting effects on aquatic organisms were similar. Combustion of these two obscurants and their deposition in water leads to the formation of many complex oxyphosphoric acids. Rates of hydrolysis of these complex products to orthophosphate were inconsistent and unpredictable over time. These products acidify water and produce toxic effects after exhausting the buffering capacity of the water. The 96-hr median lethal concentration (LC50) values for fish ranged from 3.9 to 5.1 pH units. The values for invertebrates ranged from 3.4 to 5.5. Algal growth was inhibited at pH levels less than 6.0. Acute 96-hr tests using *Daphnia* with neutralized and nonneutralized exposure solutions indicated that the presence of unidentified toxic component(s) acted independently

of pH. Additions of phosphorus into aquatic systems can lead to stimulation of algal growth as long as the resulting pH is not toxic. Neither the bulk fog oil nor the vaporized fog oil was acutely toxic to freshwater animals at concentrations less than 10 mg/L total oil. Concentrations of bulk fog oil in excess of 2.4 mg/L total oil significantly inhibited algal growth in two of the three batches tested. Photolysis increased the concentration of water soluble components of the fog oil. The three obscurants tested have the potential for adverse environmental effects.

National Technical Information Service (NTIS): ADA167 900/0/XAB

Toxicity/Environmental Impact/Aquatic Organisms/Smoke/Water Pollution/Adverse Conditions/Algae/Aquatic Biology/Bulk Materials/ Combustion/Deposition/Fresh Water/Fuels/Hydrolysis/Invertebrates/ Lethal Dosage/Materials/Mineral Oils/Photolysis/Rates/Smoke Generators/Smoke Screens/ Solutions(General)/Stimulation(General)/ Water/Obscuration/Smoke Munitions/Plant Growth/White Phosphorus/ Butyl Rubber/Phosphoric Acids/*Daphnia*.

Pritchard, P. H., Mueller, L. H., Spain, J. C., and Bourguin, A. W. Degradation of Jet and Missile Fuels by Aquatic Microbial Communities. Environmental Research Laboratory, Gulf Breeze, FL. 1987 Jul:175.

The fate of jet fuel (JP-4) in aquatic sediments was studied concomitantly in laboratory test systems and in the field. Sediments from an estuarine pond were dosed with jet fuel and then reapplied to the pond as well as into plexiglass trays on the sediment bed and quiescent bottle tests in the laboratory. Thirty-three selected hydrocarbons in the jet fuel were followed chemically to quantitate relative hydrocarbon losses. Several hydrocarbons that biodegraded or rapidly volatilized in the bottle tests were much slower to disappear in the field and the plexiglass trays. In general, mixing of the jet fuel with sediments increased the persistence of the associated hydrocarbons. The fate of missile fuels in aquatic systems was also investigated. The high density missile fuels RJ-5 and JP-9 resisted biodegradation when incubated with water/sediment suspensions collected from aquatic habitats. RJ-5 and JP-9 were not toxic to the microbial communities at concentrations of 400 mg/L, but RJ-5 was toxic to *Mysidopsis bahia* in 96-hr acute tests (LC50 88 μg/L).

National Technical Information Service (NTIS): ADA188 065/7/XAB

Aquatic Animals/Aquatic Biology/Aquatic Organisms/Biodeterioration/ Communities/Environmental Impact/Estuaries/Habitats/Jet Engine Fuels/ Laboratory Tests/Microorganisms/Plexiglass Ponds/Sediments/Trays/

Water/Water Pollution/Pollution Abatement/Rocket Fuels/Soil Tests/ Ocean Bottom Soils.

Racine, C. H., Walsh, M. E., Roebuck, B. D., Collins, C. M., Calkins, D., Reitsma, L., Buchli, P., and Goldfarb, G. White phosphorus poisoning of waterfowl in an Alaskan salt marsh. J. WILDL. DIS. 1992; 28(4):669-673.

The cause of the yearly death of an estimated 1,000 to 2,000 migrating dabbling ducks (*Anas* spp.) and 10 to 50 swans (*Cygnus buccinator* and *C. columbianus*) has remained a mystery for the last 10 years in Eagle River Flats (ERF), a 1,000-ha estuarine salt marsh near Anchorage, Alaska, used for artillery training by the U.S. Army. We have gathered evidence that the cause of this mortality is the highly toxic, incendiary munition white phosphorus (P sub(4)). The symptoms of poisoning we observed in wild ducks included lethargy, repeated drinking, and head shaking, and rolling. Death was preceded by convulsions. Farm-reared mallards dosed with white phosphorus showed nearly identical behavioral symptoms to those of wild ducks that became sick in EFR. While phosphorus does not occur in nature but was found in both the sediments where dabbling ducks and swans feed and in the gizzards of all carcasses collected in ERF. We hypothesize that feeding waterfowl are ingesting small particles of the highly toxic, incendiary munition P sub(4) stored in the bottom anoxic sediments of shallow salt marsh ponds.

Aquatic Birds/Phosphorus/Toxicity/Salt Marshes/Military/ Operations/ Chemical Explosives/Chemistry/Environmental Transport/Root Absorption/Safety/Soil/Toxicity/Meetings.

Rhodes, J. E., Adams, W. J., Biddinger, G. R., Robillard, K. A., and Gorsuch, J. W. Chronic Toxicity of 14 Phthalate Esters to *Daphnia magna* and Rainbow Trout (*Oncorhynchus mykiss*). Environmental Toxicology and Chemistry 1995; 14(11):1967-1976.

Chronic toxicity studies were performed with commercial phthalate esters and *Daphnia magna* (14 phthalates) and rainbow trout (*Oncorhynchus mykiss*) (six phthalates). For the lower molecular-weight phthalate-esters dimethyl phthalate (DMP), diethyl phthalate (DEP), di-n-butyl phthalate (DBP), and butylbenzyl phthalate (BBP), the results of the studies indicated a general trend in which toxicity for both species increased as water solubility decreased. The geometric mean maximum acceptable toxicant concentration (GM-MATC) for *D. magna* ranged from 0.63 to 34.8 mg/L. For the higher molecular-weight phthalate-esters dihexyl phthalate (DHP), butyl 2-ethylhexyl phthalate (BOP), di-(n-hexyl, no-ctyl, n-decyl) phthalate (610P), di-(2-ethylhexyl) phthalate (DEHP), diisooctyl phthalate (DIOP), diisononyl phthalate (DINP), di(heptyl, nonyl, undecyl) phthalate (711P), diisodecyl phthalate (DIDP), diundecyl phthalate (DUP),

and ditridecyl phthalate (DTDP), the GM-MATC values ranged from 0.042 to 0.15 mg/L. Survival was equally sensitive and sometimes more sensitive than reproduction. The observed toxicity to daphnids with most of the higher molecular-weight phthalate-esters appeared to be due to surface entrapment or a mode of toxicity that is not due to exposure to dissolved aqueous phase chemical. Early life-stage toxicity studies with rainbow trout indicated that survival (DMP) and growth (DBP) were affected at 24 and 0.19 mg/L, respectively. This pattern of observed toxicity with the lower molecular-weight phthalate esters and not the higher molecular-weight phthalate esters is consistent with previously reported acute toxicity studies for several aquatic species.

Water Resource Abstracts: 3856094

Daphnia magna/Oncorhynchus mykiss/Phthalate Esters/Toxicity Testing/ Platicizers/Toxicity/Trout/*Daphnia*/Esters/Plastics/Water Pollution/ Sublethal Effects/Toxicity Tests/Esters/Industrial Wastes/Test Organisms/ Bioassays.

Roberts, W. C. Data Summary for Trinitrotoluene. Army Medical Bioengineering Research and Development Laboratory, Fort Detrick, MD. 1986 Sep:37.

TNT is produced in a batch or continuous mode by reacting toluene with nitric acid in presence of sulfuric acid. Manufacture and load, assembly, and pack (LAP) operations provide several opportunities for TNT and its products to enter the environment. Wastewater discharged from Army ammunition plants (AAPs) is the primary way that TNT enters the aquatic environment. Up to 60 mg/L of TNT have been found in stream and river waters that receive waste effluent from AAPs, and associated sediments have contained up to 617 mg/kg. TNT does not transport very well through soil into groundwater, and atmospheric transport is not environmentally significant. It is persistent in soils, but is rapidly degraded in aquatic environments.

National Technical Information Service (NTIS): ADA199 118/1/XAB

Ammunition/Aquatic Biology/Army Operations/Atmospheric Physics/ Contaminants/Drinking Water/Effluents/Environments/Ground Water/ Health/Mammals/Military Facilities/Nitric Acid/Pollution Abatement/ Rivers/Sediments/Soils/Sulfuric Acid/TNT/Toluenes/Toxicology/ Transport Properties/Waste Water/Wastes/Water/Water/Pollution/Water Quality.

Ryon, M. G. Water Quality Criteria for 2,4,6-Trinitrotoluene (TNT): Final Report. Department of Energy, Washington, DC. 1987 Aug:140.

Studies of the acute toxicity of TNT to aquatic organisms indicate that LC sub 50 values range from 5.2 to 27.0 mg/L for invertebrates in 48-hr static tests, and from 2.0 to 3.7 mg/L for fish in 96-hr flow-through tests. TNT is absorbed by both humans and test animals through the skin, by ingestion, and by inhalation. Following oral absorption, sup 14 C-TNT is found at highest levels in the GI tract, liver, kidneys, and blood. The liver is the site for metabolic and detoxification activity. The primary effects of occupational exposure to TNT are jaundice with toxic hepatic and/or aplastic anemia that can be fatal. Significant effects on the hematological system occurred at mean exposure levels of 0.2 to 7.5 mg/m sup 3. Evaluations of oral TNT toxicity were reported for 90-day exposures of dogs, mice, and rats. The effects for all three species were similar and included depressed weight gain, mild to moderate anemia, enlarged livers and spleens, some testicular atrophy, and hemosiderosis of the spleen. Carcinogenicity data were limited to a 2-year study of rats that indicated hyperplasia and carcinoma of the urinary bladder in females at the highest dose (50 mg/kg/day). Standards for TNT occupational exposures have been recommended by OSHA (TLV of 1.5 mg/m sup 3), U.S. Army (0.5 mg/m sup 3), and ACGIH (TLV of 0.5 mg/m sup 3 and STEL of 0.3 mg/m sup 3). Drinking water limits of 0.03 to 0.05 mg/L were recommended by the U.S. Army and Navy. Available data for calculating water quality criteria were insufficient to meet all the USEPA guideline requirements. However, a reasonable estimate of the criterion maximum concentration is 557 μg/L.

National Technical Information Service (NTIS): DE88002474/XAB

TNT/Aquatic Ecosystems/Dogs/Drinking Water/Effects/Evaluation/ Fishes/Health Hazards/Ingestion/Invertebrates/Larvae/Lethal Doses/Man/ Mice/Progress Report/Rats/Reviews/Standards/Toxicity/Water Quality.

Ryon, M. G., Pal, B. C., Talmage, S. S., and Ross, R. H. Database Assessment of the Health and Environmental Effects of Munition Production Waste Products. Oak Ridge National Laboratory, TN. 1984 Aug:228.
A database on the health and environmental aspects of munition production waste products is presented. Information on production processes and waste treatment methods is also presented.

National Technical Information Service (NTIS): ADA145 417/2

Wastes(Industrial)/Waste Treatment/Environmental Impact/Chemical Properties/Munitions Industry/Manufacturing/Water Pollution/Air Pollution/Pollutants/Degradation/Metabolites/Databases/Toxic Hazards/ Lethal Dosage/Impurities/Heavy Metals/Public Health/Waste Water/

Aquatic Organisms/Waste Disposal/Sediments/Nitrogen Oxides/Sulfur Oxides/Toluenes/Triazines/Nitramines/Methanes/Nitrates/RDX HMX/ Tetrazocine/Acetyloctahydrotrinitor Triazine/Acetylhexahydrodinitro.

Scherfig, J., Dixon, P., Petty, M. A., and O'Brien, E. Use of Unicellular Algae for Evaluation of Potential Aquatic Contaminants. California University, Irvine. 1982 Oct:62.
Selenastrum capricornutum was used as test algae in bioassays to determine the no-effect level (NOEL), effective concentration (EC_{50}), and maximum allowable toxic concentration (MATC) for conventional JP-4, JP-8, shale-derived JP-4, and shale-derived JP-8 with and without clay treatment. Preliminary investigations were conducted to evaluate the relative toxicity of a reference jet fuel mixture composed of equal parts of 15 major fuel compounds. Techniques and protocols are described, and the results are discussed.

National Technical Information Service (NTIS): ADA121 273/7

Algae/Toxicity/Jet Engine Fuels/Water Pollution/Bioassay/Culture Media/ Continuous Processing/Electron Microscopy/Neutron Activation/Dosage/ Contamination/Contaminants.

Slonim, A. R. Behavior of Hydrazine Compounds in Hard and Soft Water. Aerospace Medical Research Laboratory, Wright Patterson AFB, Ohio. 1975 Sep:26.
The behavior of hydrazine, 1,1-dimethylhydrazine (known also as unsymmetrical dimethylhydrazine, UDMH), Aerozine-50, and onomethylhydrazine (MMH) in hard and soft water was studied prior to evaluating their effects on aquatic organisms. Hard and soft water solutions were examined over a 96-hr period for changes in physical characteristics, phenolphthalein and total alkalinity, pH, specific conductance, EDTA hardness, and dissolved oxygen (DO). All four compounds at low concentrations (0.1 and 1.0 mg/L) had no effect on these variables, but at 100 mg/L produced changes that were significantly different between hard and soft water, indicating an appreciable amount of coordination of hydrazine compounds with calcium and other hard water ions. The oxygen level was reduced by all four compounds at 100 mg/L usually within the first day; in one detailed study, hydrazine in hard water caused the greatest drop in DO at 5 to 13 hr of exposure. In general, the propellant effects were not of a magnitude to preclude conducting acute toxicity tests in an open static bioassay.

National Technical Information Service (NTIS): ADA019 401/9

Hydrazine/Water Pollution/Degradation/Dimethyl/Hydrazine (11)/ Chemical Properties/Hard Water/Calcium/Oxygen/Liquid Rocket Propellants/Metal Complexes/Aquatic Organisms/Ground Water/Physical Properties/Stability/Toxicity/Water/pH Factor/Reduction(Chemistry)/ Distilled Water/Solutions(Mixtures)/Hardness/Alkalinity.

Small, M. J. The Hazard Ranking and Allocation Methodology: Evaluation of TNT Wastewaters for Continuing Research Efforts. Army Medical Bioengineering Research and Development Laboratory, Fort Detrick, MD. 1978 Sep: 75.
A major wastewater product from 2,4,6-trinitrotoluene manufacture is condensate water. Thirty compounds have been determined to occur relatively frequently in condensate water, including mono, di-, and trinitrotoluenes, di- and trinitrobenzene, and amino-dinitrotoluenes. Research has been underway to characterize the acute toxic nature of these compounds to aquatic species. Research has also been done to assess the mutagenic activity of these compounds via an Ames/Salmonella microbial bioassay.

National Technical Information Service (NTIS): ADA061 770/4

Waste Water/Detoxification/Hazards/DNT/TNT/Volatility/Photolysis/ Mutagen/Risk/Bioassay/Ratings/Systems Analysis/Monte Carlo Method.

Smock, L. A., Stoneburner, D. L., and Clark, J. R. Toxic Effects of Trinitrotoluene (TNT) and its Primary Degradation Products on Two Species of Algae and the Fathead Minnow. Water Research. 1976; 10:537-543.
The effects of alpha trinitrotoluene (alpha TNT) and its primary degradation product (TNTcc), commonly referred to as “pink water,” were determined on members of two tropic levels. The growth responses of the algae *Selenastrum capricornutum* and *Microcytis aeruginosa* were examined through static bioassays. Death and behavioral responses of the fathead minnow were determined using a proportional diluter.

Ei Compendex (R): EI760906224

Water Analysis/Toxicity/Water Pollution/Analysis/Biomedical Engineering.

Snell, T. W., and Moffat, B. D. A 2-D Life Cycle Test with the Rotifer *Brachionus calyciflorus*. Environmental Toxicology and Chemistry. 1992; 11:1249-1257
A 2-day life cycle test using the freshwater Rotifer *Brachionus calyciflorus* was developed for assessing chronic toxicity. The end point for this test is,

the intrinsic rate of increase, which has high ecologic relevancy because it measures the growth potential of a population. The test is multi-generational because two-thirds of the reproduction is attributable to parental females and one-third to F subscript 1 females. Despite its brevity, the Rotifer test includes 30 percent more of test animal life span than a 7-day *Ceriodaphnia* test. Test protocol is simple to execute, with the test animals obtained by hatching cysts and the algal food obtained from petri dish cultures. A small volume of test solution (120 ml) is required for a test, making the Rotifer test potentially useful for conducting chronic toxicity identification evaluations (TIEs), in which test solution availability and exposure duration can be important. Analysis of the person hours required to execute a test shows the Rotifer test requires 70 percent less effort than 7-day *Ceriodaphnia* or fathead minnow tests. The simplicity of the Rotifer test contributes to its excellent reproducibility. The comparative sensitivity of the Rotifer life cycle test is not yet fully characterized, but for the five compounds compared in both *Ceriodaphnia* and *Brachionus*, the chronic values of four were within a factor of six of one another. At the chronic value concentrations of 11 toxicants tested in radiferous, there was an average 33 percent reduction in r as compared to controls.

Water Resource Abstracts: 9303725

Chronic Toxicity/Ecotoxicology/Laboratory Methods/Life Cycles/ Radiferous/Toxicity/Toxicology/Biological Studies/*Daphnia*/Growth Rates/Reproduction/Sublethal Effects.

Sullivan, J. H., Jr., Putnam, H. D., Keirn, M. A., Pruitt, B. C., Jr., and Nichols, J. C. A Summary and Evaluation of Aquatic Environmental Data in Relation to Establishing Water Quality Criteria for Munitions Unique Compounds. Part 2. Nitroglycerin. Water and Air Research, Inc., Gainesville, FL. 1979:50

The purpose of this report is to review the effects of nitroglycerin (TNG) on the aquatic environment and to recommend water quality criteria for the protection of aquatic organisms. Chemical properties, analytical methods, manufacturing wastewater characteristics, and environmental fate of TNG are reviewed and discussed. Three procedures were utilized to determine the recommended water quality criteria for TNG: (1) a new proposed procedure by USEPA; (2) acute toxicity values multiplied by a general application factor; and (3) acute toxicity values multiplied by an experimentally derived application factor. Considering the results of these three procedures and the data from the chronic studies, a water quality criteria for TNG of 0.01 mg/L (24-hr average) was recommended.

National Technical Information Service (NTIS): ADA082 437/5

Nitroglycerin/Toxicity/Water Pollution/Water Quality/Chemical Properties/Waste Water/Fishes/Aquatic Animals/Microorganisms/ Metabolism/Mammals/Databases/Physical Properties/Industrial Production/Identifiers.

Sullivan, J. H., Jr., Putnam, H. D., Keirn, M. A., Pruitt, B. C., Jr., and Nichols, J. C. A Summary and Evaluation of Aquatic Environmental Data in Relation to Establishing Water Quality Criteria for Munitions Unique Compounds. Part 4: RDX and HMX. Water and Air Research, Inc., Gainesville, FL. 1979 Mar:71.
The effects of RDX and HMX on the aquatic environment were reviewed and water quality criteria for the protection of aquatic organisms are recommended. Chemical properties, analytical methods, manufacturing wastewater characteristics, and environmental fate of RDX and HMX are reviewed and discussed. The database for RDX consists of acute tests with four species of freshwater algae, acute and chronic tests with four and two species of freshwater invertebrates, respectively, and acute and chronic tests with four and two species of freshwater fish, respectively. The database for HMX is more limited, consisting of acute tests on four species of freshwater algae, acute tests on four species of freshwater invertebrates, and acute tests on four species of freshwater fish. Effects were observed only at nominal concentrations exceeding the solubility of HMX. Three procedures were utilized to determine the recommended water quality criteria for RDX and HMX: (1) a proposed procedure by USEPA, (2) acute toxicity values multiplied by a general application factor, and (3) acute toxicity values multiplied by an experimentally derived application factor. For RDX, a 24-hr average concentration of 0.30 mg/L should adequately protect aquatic life. Insufficient data exist to establish a criteria for HMX.

National Technical Information Service (NTIS): ADA087 683/9

Waste Water/Aquatic Organisms/RDX/HMX/Water Quality/ Concentration(Chemistry)/Industrial Plants/ Munitions Industry/Toxic Hazards/Environmental Protection/Fresh Water/Algae/ Fishes/ Invertebrates/Water Treatment

Toussaint, M. W., Shedd, T. R., van der Schalie, W. H., and Leather, G. R. A Comparison of Standard Acute Toxicity Tests with Rapid-Screening Toxicity Test. Environ Toxicol Chem. 1995 May; 14(5):907(9).
Commercially available rapid toxicity tests were compared with five standard aquatic acute toxicity tests in terms of sensitivity. The toxicity data were gleaned from the literature and from laboratory test results. The test compounds were copper, cadmium, pentachlorophenol, sodium

dodecyl sulfate, ammonia, octanol, phenol, Malathion, 2,4-D, and 2,4,6-trinitrotoluene. The rapid test methods included the Rotifer, brine shrimp, polytox, and lettuce root elongation tests. With the exception of Malathion, the standard acute toxicity test results for each compound fell within roughly an order of magnitude range. The rapid test results in this range for pentachlorophenol, trinitrotoluene, octanol, sodium dodecyl sulfate, 2,4-D, and ammonia. Only the lettuce and Rotifer tests for the metals and the lettuce and Microtox tests for phenol fell within the approximate order of magnitude range as the standard acute toxicity tests. While no one rapid test was comparably sensitive to the standard tests for all of the compounds evaluated, a combination of tests could better mimic the standard acute toxicity test results to the panel of compounds.

Enviro-line: 9509977

Sensitivity/Bioassay/Measurements and Sensing/Toxic Substances.

van der Schalie, W. H. Acute and Chronic Toxicity of 3,5Dinitroaniline, 1,3-Dinitrobenzene, and 1,3,5-Trinitrobenzene to Freshwater Aquatic Organisms. Army Medical Bioengineering Research and Development Laboratory, Fort Detrick, MD. 1983 Oct:55.

The toxicity to freshwater aquatic organisms of three compounds formed during the continuous manufacturing process for 2,4,6-trinitrotoluene (TNT) was determined. The compounds were 1,3-dinitrobenzene (DNB), 3,5-dinitroaniline (DiNA), and 1,3,5-trinitrobenzene (TNB). Four species of fish (fathead minnow, rainbow trout, channel catfish, and bluegill), one aquatic invertebrate (*Daphnia magna),*and one algae (*Selenastrum capricornutum*) were tested. Emphasis was on determining the threshold levels of toxicity to the species found to be most sensitive to the test materials.

National Technical Information Service (NTIS): ADA138 408/0

Toxicity/Nitrobenzenes/Anilines/Nitro Radicals/Fresh/Water/Aquatic Organisms/Algae/Fishes.

van der Schalie, W. H. Toxicity of Nitroguanidine and Photolyzed Nitroguandine to Freshwater Aquatic Organisms. Army Medical Bioengineering Research and Development Laboratory, Fort Detrick, MD. 1985 Mar:36.

The acute toxicity of nitroguanidine (NGu) to 10 species of freshwater aquatic organisms was determined. Fish exposed to NGu for 96 hr included fathead minnows (*Pimephales promelas*), bluegills (*Lepomis macrochirus*), channel catfish (*Ictalurus punctatus*), and rainbow trout

(*Salmo gairdneri)*. Invertebrates that were tested for 48 hr included water fleas (*Daphnia magna*), amphipods *(Hyalella azteca* and *Gammarus minus*), midge larvae (*Paratanytarsus dissimili*), and aquatic worms (*Lumbriculus variegatus*). The acute toxicity of NGu was very low; less than 50 percent of any of these organisms exposed to NGu were killed at concentrations up to the solubility limit of NGu in water, which ranged from about 1,700 mg/L at 12 °C (trout tests) to about 3,000 mg/L at 22 °C (most other species). Complete photolyzation of NGu with ultraviolet light greatly increased NGu toxicity. The toxicity of phi-NGu decreased with time but was still much more toxic than NGu.

National Technical Information Service (NTIS): ADA153 045/0/XAB

Nitroguanidine/Aquatic Organisms/Toxicity/*Daphnia*/Concentration (Chemistry)/Algae/Fishes/Minnows/Crustacea/Larvae/Photolysis/Trout.

Wams, T. J. Diethylhexylphthalate as an environmental contaminant--A Review. Sci Total Environ. 1987; 66:116.

Di(2-ethylhexyl)phthalate (DEHP) is a priority pollutant in several countries; annual production amounts to 3-4 million tonnes. Approximately 95 percent is used as a plasticizer in polyvinyl chloride (PVC). DEHP is emitted to the environment during the production of plastics and plastic products, during their use and after disposal. In the environment, physicochemical degradation of DEHP is practically nonexistent. Biodegradation occurs readily under aerobic conditions (t1/2 = 24 weeks), but not under anaerobic conditions. The acute toxicity of DEHP to mammals is low. Many subchronic and chronic effects have, however, been identified. The most important of these are influence on the liver and energy metabolism, teratogenicity, adverse effects on male reproductive organs, carcinogenicity, and influence on the immune system. On the basis of figures for human exposure, most of these effects are not likely to occur. With respect to carcinogenicity the situation is uncertain, especially for some risk groups. The Ecotoxicology of DEHP is especially relevant for aquatic communities where data are contradictory: several authors have found adverse effects on *Daphnia* and fish species after exposure to the present environmental concentrations; others, however, produced less alarming results. Emissions of DEHP can be reduced by the biological treatment of wastewater and waste gas, the use of alternative plasticizers in PVC or the substitution of other plastics for PVC.

TOXLINE subfile TOXBIB:8070523

Diethylhexyl Phthalate--Analysis--AN/Environmental Pollutants--Analysis--AN/Phthalic Acids--Analysis--AN/Abnormalities/Drug-Induced--Etiology--ET/Diethylhexyl Phthalate--Metabolism--ME/

Diethylhexyl Phthalate--Toxicity--TO/Environmental/Pollutants--Metabolism--ME/Environment/Pollutants--Toxicity--TO/Half-Life/Infertility/Male/Chemically Induced--CI/Lethal Dose 50/Liver Neoplasms/Experimental Chemically Induced--CI/ Mice/Netherlands/Plastics/Rats/Refuse Disposal/Sewage/Water Pollutants/Chemical--Toxicity--TO/(Environmental Pollutants)/(Phthalic Acids)/Chemical)/117817 (Diethylhexyl Phthalate).

Water Quality Assessment for the Proposed RDXHMX Facility Newport Army Ammunition Plant. **Water and Air Research, Inc., Gainesville, FL**. **1976 Feb: 199**.
This environmental assessment directs itself to the impact of an RDX-HMX manufacturing facility at Newport Army Ammunition Plant. The waste discharge of the proposed facility will enter the Wabash River 3 miles above Montezuma, IN, carrying munitions residues and compounds associated with their manufacture. Presently, only TNT is produced at NAAP, and waste loading effects will contain these residues along with those of RDX-HMX. The impact of treated NAAP wastes on the Wabash River will be limited to possible slight biostimulatory effects from increased nitrate nitrogen. Discharge of even raw RDX-HMX waste would have a negligible effect on oxygen balance in the Wabash River under average flow conditions.

National Technical Information Service (NTIS): ADA026 207/1

Environmental Impact Statements/Munitions Industry/Water Pollution/Water Quality/RDX/HMX/Waste Water/TNT/Nitrates/Water Analysis/Fishes/Invertebrates/Aquatic Organisms.

Won, W. D., DiSalvo, L. H., and Ng, J. Toxicity and Mutagenicity of 2,4,6-Trinitrotoluene and Its Microbial Metabolites. Applied and Environmental Microbiology. 1976 Apr; 31(4):576-580.
TNT (2,4,6-trinitrotoluene)of explosive grade is highly toxic to marine forms that included fresh water unicellular green algae (*Selenastrum capricornutum*), tidepool copepods (*Tigriopus californicus*), and oyster larvae (*Crassostrea gigas*), and mutagenic to *Salmonella typhimurium*. On the basis of mutagenic assays carried out with a set of histidine requiring strains of the bacterium, TNT was detected as a frame shift mutagen that significantly accelerates the reversion rate of a frame shift tester, TA-98. In contrast, the major microbial metabolites of TNT appeared to be nontoxic nonmutagenic.

National Technical Information Service (NTIS): ADA026 497/8

TNT/Biodeterioration/Water Pollution/Toxicity/Mutagen/Metabolites/ Microorganisms/Algae/Oysters/*Salmonella typhimurium*/Larvae/ Mortality Rates/Aquatic Organisms.

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List of Search Words:

Aquatic and Toxicity were added to each search word that is listed below:

de-greasers
de-icers
dinitrotoluene
explosives
hexachloroethane or HC
hexogen
HEXYL
HMX
HMT
jp-4
jp-8
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NQ
obscurants
PETN
phossy water
phthalate esters
picric acid
pink water
propellant
RDX
Sarin
SEX
smoke
Soman
Tabun
TAX
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TETRYL
TNT
trinitramine
trinitrobenzene
trinitrophenol
white phosphorus
zinc hydrochloroethane

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Defense Technical Information Center (DTIC)

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Sci-Search

ToxLine

Water Resource Abstracts (WRA)

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	April 1998	Final report

4. TITLE AND SUBTITLE
Toxicity of Military Unique Compounds in Aquatic Organisms: An Annotated Bibliography (Studies Published Through 1996)

5. FUNDING NUMBERS

6. AUTHOR(S)
Environmental Laboratory

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
U.S. Army Engineer Waterways Experiment Station
3909 Halls Ferry Road, Vicksburg, MS 39180-6199

8. PERFORMING ORGANIZATION REPORT NUMBER
Technical Report IRRP-98-4

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
U.S. Army Corps of Engineers
Washington, DC 20314-1000

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES
Available from National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.

12a. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT ***(Maximum 200 words)***

This report contains information on the effects of military unique compounds on aquatic organisms. Over 100 published studies were assimilated from various on-line databases. For each study a full citation, followed by a complete abstract, database accession number, and keyword list, is provided. An alphabetized appendix containing hundreds of military-related keywords, along with corresponding authors' names, is included.

14. SUBJECT TERMS
Aquatic
Explosives
Jet fuels
Munitions
Obscurants
Toxicity

15. NUMBER OF PAGES
93

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED		